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THE

ANATOMY

OF THE

HUMAN BODY.

VOL. II.

CONTAINING THE

ANATOMY

OF THE

HEART AND ARTERIES.

By JOHN BELL, Surgeon.

THE SECOND EDITION, CORRECTED.

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DR. JAMES JEFFRAY,

PROFESSOR OF ANATOMY IN THE UNIVERSITY OF GLASGOW.

Dear Sir,

When this volume firſt appeared, you mentioned to me ſome doubts concerning the office which I had aſcribed to the Euſtachian valve. You propoſed to publiſh ſome critical obſervations on this part of my Book, and, with a liberality becoming our common profeſſion, and your high ſtation in it, you ſpoke of addreſſing thoſe ſtrictures to myſelf.

It is no ſmall gratification to me, that I have it now in my power to preſent a new Edition of this Volume, imperfect as it is, to one who allows it ſome merit, while he is yet not inſenſible to its defects.

I believe

I believe you will accept with pleaſure this ſlight teſtimony of reſpect and eſteem, from one who can have no motive but reſpect and eſteem for profeſſing himſelf in this particular manner.

Your moſt faithful and obedient
Humble Servant,

JOHN BELL.

PREFACE.

THIS volume conſiſts of two parts; the Anatomy and Phyſiology of the Heart—the Arrangements and Deſcriptions of all the Arteries of the Body.

THE diſcovery of the circulation of the blood has been always regarded as one of the moſt important, and has been ranked rather with the great doctrines of philoſophy, than with the little diſcoveries in our peculiar ſcience; it has been boaſted of by our countrymen, and much coveted, and often claimed, by ſtrangers. The diſcovery is moſt ingenious and beautiful, and is the foundation of all that phyſicians have thought or practiſed, right or wrong, uſeful or deſtructive, ever ſince.

How the well-proved doctrines of Harvey were perverted; what new, ſtrange, monſtrous, and impoſſible circles his antagoniſts contrived for the blood it were tedious to relate; but it is moſt natural to mention why his doctrines were oppoſed. It was the univerſal opinion in thoſe days, that the blood was formed in the liver, and ſent out from it by all the veins to nouriſh the body, proceeding outwards during the day, and returning by night. The old phyſicians had thus entered into a train of thinking which it was not eaſy to change: theſe notions about the blood were become great and important doctrines, and had deſcended to them from their oldeſt teachers, with many weighty dependencies, concluſions, and rules of practice iſſuing from them: they were as articles of faith which it was a hereſy to forſake; and it was eaſy to foreſee, that ſhould the Harveian doctrine prevail; ſhould it be once completely proved that the blood moved outwards along the arteries and returned only by the veins; then all the reaſonings of the phyſicians would be confounded; their theories embracing the whole body of phyſic diſturbed; their ſyſtem of practice entirely overthrown; and all that they had written themſelves, and all the ancient books which they had read with ſo much diligence (for they were really learned); all that they had ever been proud of; was to be wiped out from the thoughts of that and of all ſucceeding ages!

But the doctrine of Harvey did at laſt prevail, diſpelled thoſe idle dreams of humours and temperaments, and ſpirits, and blood! of the blood concocted in the liver, and moving outwards along the veins to nouriſh the body; of the blood moving outwards during all the day, and returning by night; of the arteries carrying air only or vital ſpirits, to animate the ſyſtem by mixing with the blood, while the veins alone conveyed the proper blood. Yet this theory of the illuſtrious Harvey introduced general doctrines more miſchievous in all their conſequences than thoſe which had juſt vaniſhed: as, that the blood was compoſed of particular globules, the larger globules of ſmaller ones, and theſe again of globules of a third ſeries; and that the arteries were ſo proportioned to the diameters of thoſe globules, and deſcended by ſteps ſo regular and uniform, that each kind of artery had its peculiar globule which it received with eaſe, while others were rejected; or, if unhappily driven by a too violent action into veſſels which they did not ſuit, were arreſted in their progreſs; and produced either ſome local inflammation or ſome univerſal diſeaſe. Theſe are the once famous doctrines of Malpighi, Boerhaave, and all the great men of their day; and which they dilated into various forms, and adorned with the fine words of lentor, remora, error loci.

To theſe ſucceeded the mechanical phyſicians, who, by unintelligible problems of mathematics and algebra (reaſonings which were ill-founded in their principles, even had the calculations been correct), pretended to eſtimate the force of the heart, the velocity of the blood, the power of the arteries, the ſtrength of the veins, and the ſhape and ſize of each ſecreting orifice, according to the ſecretion which it had to perform. Theſe were the doctrines, theſe the diſcoveries, which rendered famous the names of Bellini, Pitcairn, Keil, Hales, and other mechanical phyſicians, whoſe books are gone "to the vault of all the Capulets."

The chemiſts next ſoon turned their thoughts, from the vain ſearch after the univerſal ſolvent and the philoſopher's ſtone, to pharmacy and the uſeful arts. By the abilities and induſtry of Newman, this branch began to aſſume the more reſpectable appearance of a uſeful art; it began to be allied to ſcience, and its connection with medicine was found to be of the moſt direct and important nature.

Having analyſed the materials of the druggiſt, the chemiſts proceeded to analyſe the parts of the human body to which thoſe medicines were to be applied: but from this rational commencement followed one of the moſt trivial of all the miſerable doctrines with which our ſcience has been diſgraced; for as the chemiſts had already explained the properties of the ſalts, metals, earths, and of all active ſubſtances, by the angles, cubes, or other forms which they ſaw their particles aſſume, they ſoon perſuaded themſelves that ſuch forms as cubes, wedges, ſpiculæ, &c. exiſted in the blood; and acid and alkaline humours, ſharp, corroſive, irritating, and pointed particles, were the terms in which they expreſſed their moſt admired theories; and acids, alkalis, and metals, and medicines for rounding the pointed particles, or obtunding (as they termed it), or ſheathing, or covering the acrimonious humours, were their chief preventatives and cures.

Until the preſent day this fault has pervaded all the great theories, that in deſcribing our veſſels phyſicians have continued to uſe the language of hydraulics and hydroſtatics; of a philoſophy applicable only to rigid tubes: in ſhort, in deſcribing the living ſyſtem, they have forgotten that it was endowed with life.

We alſo may have erred in our turn: but with whatever degree of contempt we may view the doctrines of theſe older authors; or however ſucceeding generations may be amuſed with ours—ſtill this is plain, that the moſt important facts in all anatomy, and the chief doctrines of the human body, muſt always accompany the explanation of thoſe two great functions of the heart and lungs. Of courſe the conſtitution of the blood; the chemiſtry of airs; our dependence, ſo inceſſant and immediate, upon the atmoſphere in which we live; the various and ſingular ways by which the fœtuſes of different creatures, or the creatures themſelves, according to their peculiar modes of life, draw their exiſtence from the atmoſphere; the various kinds of circulation by which this air is diſtributed through the ſyſtem of each; the effects of air particularly upon our body; and the effects alſo of accidents, deformities, and diſeaſes in thoſe prime organs—all this wide circle of phyſiology belongs, in the ſtricteſt and cleareſt ſenſe, to the anatomy of the heart. For one chief purpoſe in ſtudying the anatomy of the human body is to underſtand its functions, and to compare them with thoſe of other creatures, till we arrive at laſt at ſome diſtant conception of the whole; of the various ſtructures of animals and vegetables; and of the various functions which in each of theſe claſſes ſupport life, and action, and through it the principle of life.

There is no occaſion on which this deſire of knowledge, this willing admiration of the wonders of nature, is ſo ſtrong as on firſt ſtudying the functions of the lungs and heart; for upon the conjoined offices of the heart and lungs all perfect life ſeems to depend. And how univerſal theſe two functions are; how neceſſary to the ſupport of the greater animals; how eſſential alſo to the conſtitution of the meaneſt inſect—it ſhall be my buſineſs to explain.

The knowledge of the arteries again bears along with it the whole anatomy of the human body. The nerves accompany the arteries; the lymphatics and veins twine round them; the glands and various organs are compoſed of them. The intimate ſtructure of parts is known only by underſtanding the forms of their veſſels; and as each individual part is nouriſhed by arteries, he who has ſtudied the arteries thoroughly, knows the whole.

But to the ſurgeon the knowledge of the arterial ſyſtem is valuable beyond all calculation or belief. He performs no operation in which arteries are not engaged; he cures no great wound in which arteries are not firſt to be tied; he enters into no conſultation in which the arteries are not firſt ſpoken of. Without a knowledge of the arteries he can neither think ſenſibly nor act ſafely.

Moſt unhappily all this comes to be known only at that period of life when the deepeſt conviction can produce only fear and perplexity, ſorrow and regret. Yet, ſtrange to tell, there is no ſuch conviction; no regret, no irreſolution, no perplexity, is ever ſeen! A ſurgeon, as ignorant of the blood-veſſels as of every other point of anatomy, ſhall proceed in his operations with a forwardneſs and boldneſs terrible to thoſe who know the danger; yet with a ſucceſs and good fortune exceeding all belief.

The cauſes of all this are very plain. A relaxation in the diſcipline of the ſchools is the firſt cauſe—an indifference to anatomy, ſo marked and pointed, that an anatomical theſis in this country was never known. Every young man eſpecially fears the difficulty of this part of anatomy, and ſhuns it. He is not duly impreſſed with ſuch a high ſenſe of its importance as to make labour pleaſant; and when he is advanced to practice, he takes comfort daily from the miſtakes and ignorance of others. A ſlender conſolation! to ſee exemplified in others the faults and dangers to which we ourſelves are expoſed.

If theſe negligencies may ſtand excuſed on any account, it is on this only, That anatomiſts have been accuſtomed to write, not for the Public, in plain and ſimple language, but for each other, in an unknown tongue. By this I mean not a foreign or a dead language, but a peculiar ſtyle and phraſe which no one can underſtand unleſs he be initiated; unleſs he have ſtudied the ſcience itſelf ſo intenſely, that he has alſo learned the jargon in which it is conveyed: in ſhort, no one but a thorough anatomiſt can underſtand the language of anatomy nor can even he underſtand it without ſome labour. Anatomiſts have buried their ſcience under the rubbiſh of names; there is not a difficult or hard ſounding word upon which they have any claim, that they have not retained: they have choked their ſubject with uſeleſs minutiæ, they have polluted their language, by transferring to it from Latin many words which, by their continual inflections in that language, were beautiful; while their unvaried, uncouth termination in ours, is barbarous in the utterance, while it tends but to interrupt and puzzle the ſenſe: "They have impreſſed into the ſervice of their ſcience a great many poor words that would get their habeas corpus from any court in Chriſtendom."

An anatomiſt, for example, will deſcribe an artery as "going to the radial edge of the ſecond metacarpal bone; then ſupplying the abductor and flexor muſcles; then going along the bone of the firſt phalanx, ſeated upon this ſecond metacarpal bone," with many other diſtortions, ambiguities, and little contrivances, to conceal (as one would believe) that he is deſcribing ſo ſimple a matter as the artery of the forefinger; which the reader at laſt finds out either by ſome lucky chance, or by reflecting how many metacarpal bones there are; and then reckoning them firſt forwards and then backwards, that he may be ſure which it is that the author means; for his author may count from the little finger towards the thumb, or from the thumb towards the little finger, or he may have a fancy of leaving out the thumb, and reckoning only four. What muſt be the ſurpriſe of any well-educated young man when he reads in thoſe books which he muſt ſtudy, of the regions of the elbow or thumb, or fore-finger? And if an anatomiſt underſtands ſuch things with difficulty, how diſtreſſing muſt they be to the ſtudent?

This is the ſcholaſtic jargon which has ſo long been the pride of anatomiſts and the diſgrace of their ſcience; which has given young men a diſlike for the moſt uſeful of all their ſtudies; and which it is now full time to baniſh from our ſchools. Theſe are the authors who avoid plainneſs as if it were meanneſs; who are ſtudious of hard words as if they conſtituted the perfection of ſcience: "it is their trade, it is their myſtery, to write obſcurely;" and full ſorely does the ſtudent feel it.

Want of arrangement, again, has ſtill worſe effects. Confuſion is a monſter in ſcience; and Thomſon has, in his Man of the Moon, deſcribed ſuch a thing with great ſpirit and life: "A creature, if that may be called a creature which had no ſhape nor form, next rolled towards him, approaching ſtill nearer and nearer, and by various glances and movements ſeemed to indicate a ſympathy with man: it was a rude unformed maſs; legs and arms, fingers and toes, and membranes and glands, and entrails and teeth, were blended into one abominable maſs."

If I ſhould tell my reader that there are very nearly one thouſand arteries in the body, going promiſcuouſly to bones, ligaments, bowels, and glands, muſcles, and nerves, to a thouſand unconnected difficult parts, all of which he muſt know by name, how would he be affected? But when I obſerve, that theſe go to the neck, the head, the arm, the leg, he begins to ſee this confuſion of muſcles, and glands, and bowels, vaniſh, and to perceive that all theſe arteries may be uſefully and very ſimply arranged. When he is next taught to know the courſe of each greater artery, and the parts in which each diviſion and branch of it lies, he perceives clearly that the parts through which it runs, as the arm-pit, neck, or groin, muſt limit and regulate the number of its branches, and give to each twig even an appropriate place and name: When next the whole arterial ſyſtem is marked and chalked out for him in different portions; when there are points of peculiar importance ſet apart which he is charged to learn with particular care—he ſees a good end in all this toil; he begins with courage, and gets forward eaſily; it becomes an intereſting, and of courſe a pleaſing, taſk. But ſtill it is a taſk: and I entreat the young ſtudent, as he values his own honour, or the ſafety of his friends, not to bate himſelf one iota of the whole. Let him not take an indolent advantage of thoſe arrangements, which are meant to promote his induſtry, not to prevent it. Let him not read only concerning the greater arteries, neglecting the ſmaller ones, but go through the whole piece of anatomy honeſtly and fairly. He will no doubt forget in time the ſmaller arteries;

arteries; but by having ſtudied even them with diligence, he muſt remember the great and important arteries with a clearneſs of comprehenſion and arrangement, which thoſe who have not gone thus honeſtly through the whole ſtudy can never attain. Let him alſo remember, that ſtudies like theſe, well performed during his early years, do, like paſt dangers, or the remembrance of good deeds, give an eaſe and pleaſure to his after life.

The arteries, I will now venture to ſay, ſhould be with the ſurgeon as familiar as his name; and there is no argument which proves it more ſtrongly than this, that a man of real learning, of ſterling good-ſenſe, of a clear head and ſteady hand, a man accompliſhed in all other reſpects, and fitted by nature and genius for performing the moſt difficult operations, if yet he want this part of knowledge, may, in one unhappy moment, do things which he muſt think of with horror during all his life. I know well how little ſuch accidents are thought of, when at laſt the evil day comes. A ſurgeon hardly believes this ſtrict knowledge of the arteries to be ſo great a point. In the midſt of an operation, or in a common wound, it gives him no concern to ſee arteries bleed which he did not look for; nor has he great reluctance to drive his needle among parts which he does not know. An artery bleeds, and he looks for it; he calls out at laſt to ſcrew the tourniquet, and it ſtops; the tourniquet is looſened again, and again it bleeds; again the ſcrew is tightened on account of the loſs of blood; he expects to ſtrike the artery; he is accuſtomed to ſtrike it, not by knowing where it lies, but by ſeeing it bleed: at laſt ſome lucky dab of the needle ſucceeds, or perhaps from faintneſs of the patient the bleeding ceaſes: the ſurgeon is relieved from his preſent anxiety; but in a few hours he is called back to this ſcene of confuſion and diſmay: yet at laſt the bleeding is ſomehow or other maſtered; and thus he gets on through all his difficulties, accident after accident, operation after operation, till at laſt he almoſt forgets that anatomy was a branch of his education, or the knowledge of blood-veſſels neceſſary in operations or wounds.

I will not ſay that a man cannot ſuppreſs a bleeding from a wound in the arm, becauſe he is not acquainted with the anatomy of the arm; but this ſurely I may be allowed to ſay, that it is a piece of knowledge which at all times, but eſpecially in thoſe circumſtances, can do no harm; and that if you leave a patient to chooſe betwixt two ſurgeons, one ſkilled in the knowledge of arteries, another knowing them only by ſeeing them ſpout out blood, it is eaſy to foretel where his choice will fall.

Perhaps ſome will be ſo hardened as to ſay, "and yet we ſeldom hear that patients die of bleeding." Is it then a merit that your patient is not plainly killed; that he does not expire under your hands? Is it nothing to loſe blood from day to day? Is it nothing that your patient is reduced to extreme weakneſs, ſuffering every thing but actual death? Is it nothing that he lies with tourniquets round the limbs in fear and anxiety, attended by young ſurgeons appointed to watch that bleeding, which may burſt out while the patient turns in bed, and deſtroy him in one moment? Is it nothing to have freſh inciſions and new ſearchings for the artery to endure?—Theſe are real difficulties and dangers, and they ſhould be provided for; our honour as well as our duty requires it. Bleeding from a great artery is to the patient the greateſt danger: the very report of an ill accident is to the ſurgeon (though, God knows, he may be blameleſs) the greateſt diſgrace; and, laſtly, though it ſhould not be ſo, his taking up a bleeding artery dexterouſly and quickly, when others have failed, is a great honour.

When we think of all the important conſequences of being thoroughly verſed in this part of anatomy, they crowd upon our imagination more in number than can be even named. The ſurgeon may, indeed, provide for the arteries to be cut in a regular operation, by conſulting books; but when he is called to a patient bleeding and faint, perhaps expiring, that perſon muſt live or die by his immediate ſkill! By his ſkill he will obtain the good opinion, not of ignorant attendants only, but of the profeſſion: and by a bold and ſenſible conduct in any difficult ſituation he may give them a leſſon of real uſe. Let us but for a moment think of the chances of thoſe wounded in war;—the alarming, unthought-of accidents which overtake us daily in private life;—the wounds and hurts which workmen receive:—let us reflect on all the kinds of aneuriſm both in the heart and arteries, from wounds, from blows, from inward diſeaſes:—let us think of all the various

rious operations in which arteries are concerned—and then declare whether, of all his ſtudies, the young man ſhould not value that moſt which makes him ſo immediately and eminently uſeful.

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THE

ANATOMY

OF THE

HEART AND ARTERIES.

BOOK I.

OF THE HEART.

CHAP. I.

OF THE MECHANISM OF THE HEART.

THE heart is placed nearly in the centre of the human body, and is itſelf the centre of the circulating ſyſtem. The ſyſtem of veſſels, which it excites and moves, conſiſts of arteries and of veins;—the arteries act with great ſtrength, with a pulſation like that of the heart itſelf, and convey the blood over all the body; the veins are in greater number, exceedingly large, pellucid almoſt in their coats, incapable of that energetic action with which all the functions of the arteries are performed; they return the blood to the heart with a flow, equable, and gentle motion, and depoſite at the right ſide a quantity of blood equal to that which is at each pulſation driven out from the left. The heart is placed betwixt the arteries and the veins, to regulate and enforce their action; to receive the blood from the veins by a ſlow dilatation, and to reſtore, by a ſudden contraction, that force which the blood loſes in paſſing round the circle of the body. But the heart has alſo another and more important office to perform; for by having two great cavities and two orders of veſſels, it performs in the ſame inſtant two circulations, one for the lungs and one for the body; it receives from the lungs nothing but pure blood, it delivers out to the body nothing but what is fit for its uſes: and this purifying or oxydation of the blood, and this excitement of the arteries, are two chief points of modern phyſiology, which every ſtep of the following demonſtration will tend to explain.

It will be moſt eaſy to conceive at firſt the idea of a more ſimple heart, of one circle, of one ſimple circulation; of one bag for receiving, and another joined to it for propelling, the blood. Indeed a heart conſiſts merely of theſe eſſential parts; a GREAT VEIN, an AURICLE, a VENTRICLE, and a GREAT ARTERY: of a vein which returns the blood from all the body; of an auricle or ſmaller bag, which receives that blood and retains it till the action of the heart is relaxed; of a ventricle (which is the proper heart), ſtrong, muſcular, very irritable, and eaſily excited, into which the auricle pours its blood; of an artery which is allied to the ventricle in ſtrength and action (as the auricle is to the vein in the delicacy of its coats), and which carries on the blood to the extremities of the body:—and the vein and artery meeting

ing in all the extremities of the body, like various branches of one tube, the whole is a circle, and the heart is the central power.

If an animal do not breathe, its ſyſtem will be what I have now deſcribed; it will have but one vein, one auricle, one ventricle, one artery; it will have one ſimple heart: but with us, and other breathing animals, it is not ſo; and I am now to deſcribe a more complex and curious circulation. For ſuppoſe this blood, ſo eſſential to our exiſtence, to have in it ſome principle of life, which is continually loſt, that principle muſt be continually renewed: the heart, which fills the arterial ſyſtem, muſt not be taken from its appointed office, nor diſturbed; nature appoints a ſecond heart, which belongs entirely to this moſt important of all functions, viz. renewing the blood; and it may be renewed in many various ways. It might, for example, circulate in ſome peculiar viſcus like the liver or ſpleen; in the fœtus it does circulate in ſuch a maſs, for the placenta is a thick and flat cake, whoſe office we know to be equivalent to that of the lungs, but whoſe ſtructure we do not underſtand: in the chick we ſee its blood circulating over the yolk (for the yolk is incloſed within the membranes of the unhatched chick), and we perceive the blood redder as it returns to the heart, and plainly changed: in fiſh we find the blood circulated over the gills, expoſed thoroughly to the water in which they ſwim, and thus the gills perform to them the function of lungs. But in all breathing creatures, the lungs do this office; the lungs are, next to the heart itſelf, eſſential to life; in thoſe who die from bleeding, we can perceive

from

from the livor of the face, from the ſobbing and ſtruggles of the cheſt, from the regular convulſive ſighs of thoſe creatures which are butchered, rather a deſire for air than a want of blood. It is for the purpoſe of this ſecond circulation that nature has appointed in every breathing creature two hearts, a heart for the lungs, and a heart for the body; two veins, two auricles, two ventricles, and two great arteries, one the pulmonic artery, or artery of the lungs, the other the aorta, or artery of the body.

But ſtill there are other varieties which diſtinguiſh animals into creatures of cold or of warm blood; for there are certain conſtitutions which do not require that the blood ſhould be thus continually renewed. It is not becauſe animals are amphibious, or go into the water, that they have peculiar lungs; for the Land Tortoiſe, the Newt, the Cameleon, never go into the water; yet they have membranous lungs: nor indeed can the Amphibiæ, as the Seal, the Porpoiſe, the Sea-Lion, &c. dive longer than a man can do; though for whole days they lie in herds baſking upon the ſhore: it is their peculiar conſtitution to need leſs than other creatures the office of the lungs. The cold-blooded animals are generally creeping animals, ſluggiſh, languid, cold, inert, difficultly moved, and tenaceous of life to a wonderful degree. They can bear all kinds of ſtimuli; they can bear to have their heads, legs, bowels, cut away; and among other peculiarities of this conſtitution, they can live long without air; they will riſe from time to time above water, if you allow them; they can bear again to be kept under water, if you force them: but if they can live long under water, they can alſo live at leaſt as long after you have cut off their heads, or cut out their hearts.

Of thoſe cold-blooded creatures always either the heart or the arteries are peculiar; the heart is ſo in many amphibiæ, as in the Turtle, where the heart ſeems to conſiſt of three ventricles, but with partitions ſo imperfect betwixt them that they are abſolutely as one: this one ventricle gives out both the great arteries; the blood of the lungs and the blood of the body are both mixed in the heart; and ſince there are two arteries conveying this mixed blood, if the two arteries be nearly equal in ſize, then it is juſt one half of the blood thrown out by the heart at each ſtroke that receives the benefit of the lungs. In many others, as the Frog, the Newt, the Toad, the peculiarity is in the arteries alone; they have one ſingle and beautiful heart; there is one large auricle as a reſervoir for all the blood both of the body and of the lungs; there is one neat, ſmall, and very powerful ventricle placed below the reſervoir, having ſtrength quite ſufficient for moving both the blood of the lungs and the blood of the body; and this ventricle gives off an aorta, which ſoon divides into two branches, one for the body and one for the lungs; and theſe of courſe have but half the blood of this heart expoſed to the air: theſe alſo are cold-blooded animals.

But all breathing creatures, ſuch as are called animals of hot blood, have two hearts: the one heart is ſending blood through the lungs while the other heart is puſhing its blood over the body; not the half only, but the whole blood which is ſent by each ſtroke of the heart over the body muſt have firſt paſſed through the lungs; no blood can reach the heart of the body which has not been ſent to it through the lungs; or, in other words, the veins of the lungs, and they alone, feed the left ſide of the heart.

Words alone will never explain any of the endleſs difficulties which concern the mechaniſm of the heart; but at every point, in every kind of difficulty, in explaining the form, the parts, the poſture, even the coats or coverings of the heart, I ſhall have recourſe to plans, ſuch as cannot fail to make all this intricate mechaniſm be eaſily conceived.

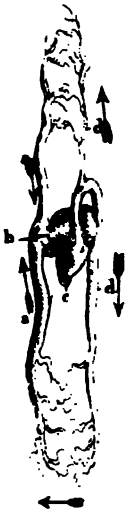
The moſt ſimple form of the heart, which is repreſented in the Plan, No. 1. has a vein marked (*a*),—an auricle (*b*),—a ventricle (*c*),—an artery (*d*);—it has no proviſion for purifying the blood; it has no reſemblance to that kind of heart which is connected with lungs; but the blood is received by the vein, falls into the auricle, is driven by its force into the ventricle, by the ventricle it is thrown into the artery, and courſes round all the body, till at length, reaching the extremities of the veins, it paſſes by the veins to the auricle a ſecond time, and ſo this ſingle circle is perfect.

The heart of the amphibious creature is repreſented in No. 2.; it is a frog's heart: it has the moſt ſimple form, and the feweſt parts; it has the ſame vein, auricle, ventricle, and artery; but its great artery divides into two chief branches, of which (*d*)—the aorta goes to the body,—(*e*) the pulmonic artery goes to each ſide of the lungs.

The heart of a breathing creature is repreſented in No. 3. in its moſt intelligible form; and the double circulation

Plans of the Heart

No 1



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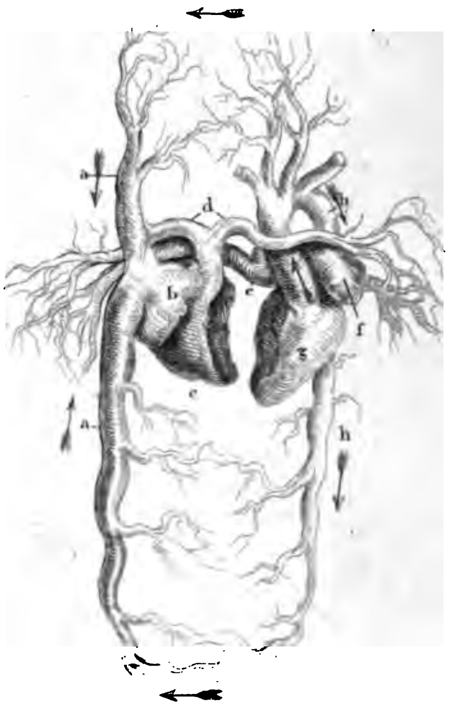

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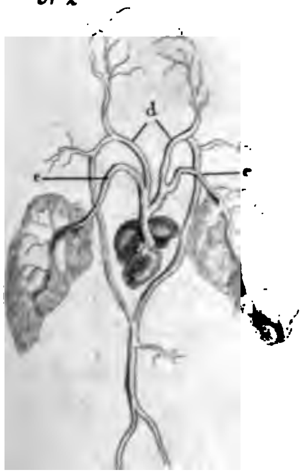

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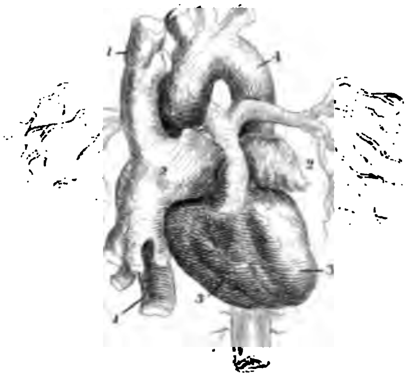

circulation of the human body may be traced eaſily in the following way.—Here the heart of the lungs is ſet off from the heart of the body, being as diſtinct in office as in form and parts; on the right ſide is the heart of the lungs, on the left ſide is the heart of the body.—(*a*) Is the great vein called VENA CAVA from its immenſe ſize;—there is an aſcending and a deſcending cava; the one brings the blood from the head and arms, the other brings the blood from all the lower parts of the body; they meet at (*a*), and form by their dilatation there a chief part of that bag which is called the auricle,—in it they depoſite all the returning blood of the body, and thus preſent it at the right ſide of the heart to be moved through the lungs.—(*b*) Is the RIGHT AURICLE; it is in part formed by a dilatation of theſe veins, but it puts on a ſtrong and muſcular nature as it approaches the heart; it is the firſt cavity of the heart, and, like all its parts, is ſtrong and irritable; it is filled by the returning blood of the Cavas; it receives, dilates, is oppreſſed by this great quantity of blood; it is ſtrongly excited to act; in its action the blood goes down into the ventricle or lower cavity of the heart.—(*c*) Is the RIGHT VENTRICLE, thick and ſtrong in its walls, and of great muſcular power; it is filled by the auricle, and is ſtrongly ſtimulated both by the ſtroke of the auricle and by the weight and quantity, and alſo, in ſome degree, by the qualities, of the blood; its action is ſudden and violent, and it drives the blood through all the ſyſtem of the lungs.—(*d*) Is the PULMONIC ARTERY,—the artery of the lungs which receives all the blood of the right ſide of the heart; it is filled by the ſtroke of the right ventricle, from whoſe cavity it ariſes; it carries the blood in many branches through all the ſubſtance of the lungs; and thus that blood which had returned imperfect and robbed of its vital quality to the right auricle of the heart, is by this circulation through the pulmonic artery ventilated and renewed, and made fit for the uſes of the ſyſtem; and thus the leſſer circulation or the circulation of the lungs, the circulation of the right ſide of the heart, is completed, and the purified blood is brought round to the left ſide of the heart to undergo the greater circulation or the circulation of the body.

Thus it is from the extremities of this firſt circle that the ſecond circle begins; it conſiſts of like moving powers, of an auricle, ventricle, vein, and artery; for as the right heart receives the contaminated blood of the body from the veins of the body, the left heart receives the purified blood of the lungs from the veins of the lungs.— (*e*) Repreſents the VEINS OF THE LUNGS, which are ſometimes three, ſometimes four, in number; two enter from each ſide of the lungs, and return the blood purified in the lungs to the left auricle of the heart.—(*f*) Is the LEFT AURICLE, ſmaller, but more muſcular and ſtronger than the right; it receives eaſily whatever quantity of blood the lungs convey to it; it is irritated, contracts, forces the mouth of the ventricle, and fills it with this purified and redder blood. —(*g*) Is the LEFT VENTRICLE, whoſe form is longer, its fleſhy walls thicker, its cavity ſmaller, its power greater far than that of the right ſide; this ventricle is thus ſmall that it may be eaſily filled and ſtimulated, and thus ſtrong that it may propel all the blood of the body.—(*b*) Is the AORTA or great artery of the body, ariſing from this left ventricle, juſt as the pulmonic artery ariſes from the right: the left ventricle, by its ſtrong and ſudden ſtroke, not only delivers itſelf of its own blood, but propels all the blood of the body, communicates its vibratory ſtroke to the extremeſt veſſels, and excites the whole; this is the greater circle or circulation of the body, as oppoſed to the ſhorter circulation or leſſer circle of the lungs.

That there are ſtrictly two hearts, is now clearly made out; they are as different in form as in office; there are two diſtinct hearts, two ſyſtems of veſſels, two kinds of blood, and two circulations. Theſe two hearts might have done their offices, though placed in the oppoſite ſides of the breaſt, it is in order to ſtrengthen mutually the effect of each other that they are joined; for the fibres of the two hearts intermix; they are both incloſed in one membranous capſule, viz. the pericardium; the veins, auricles, ventricles, and arteries, correſpond in time and action with each other, and harmonize in a very beautiful manner. But this, I believe, will be more eaſily explained by marking the ſucceſſion of motions, by a ſuite of figures placed upon the ſeveral parts of the heart, by which the ſucceſſive motions are performed.

In N° 4. I have joined the right and left hearts; both that it may be ſeen how the left heart locks in behind the right heart, how the right heart comes to be the anterior one, and how the aorta ſeems to ariſe from the centre of the heart while its root is covered by the great artery of the lungs; and alſo that the ſynchronous parts, *i. e.* the parts which beat time with each other, may be correctly ſeen.—1. The

CAVAS are receiving the blood from all parts of the body, and in the ſame inſtant the pulmonic veins are receiving blood from the lungs. 2. The RIGHT AURICLE is gradually filling with the contaminated blood of the body; the left auricle, marked alſo with a ſecond figure, is filling with purified blood from the lungs. 3. The RIGHT VENTRICLE is ſtimulated by its auricle, and throws its contaminated blood into the lungs; and in the ſame moment the left ventricle throws its purified blood over the body. 4. The PULMONIC ARTERY reacts upon the blood driven into it by the heart; and in the ſame moment the aorta reacts upon the blood thrown into it, and that reaction works it through all this great ſyſtem of veſſels from this the centre to all the extremities of the body.

Thus it is eaſy to perceive how the ſucceſſive actions accompany each other in the oppoſite ſides of the heart: 1. The two veins ſwell; 2. The two auricles are excited; 3. The two ventricles are filled with blood; 4. The two arteries take up and continue this pulſating action of the heart. It is thus that the two hearts aſſiſt and ſupport the actions of each other, and there ſeems almoſt a phyſical neceſſity for their being joined; yet on the very beſt authority, and after deliberate diſſection, we are entitled to affirm, that the heart is found, not with its apex ſharp and conical, but cleft; the two ventricles plainly diſtinct from each other and divided by a great ſpace. "Latro, quæ pœnas ſcelerum luebat, quando exenteraretur a carnifice, cor habuit ſingularis figuræ, mucrone non acuto, ut fieri ſolet, ſed bifido; ut diſtincti ventriculi manifeſtius externa facie apparuerint, dexter nempe et ſiniſter, interjecto magno hiatu *."

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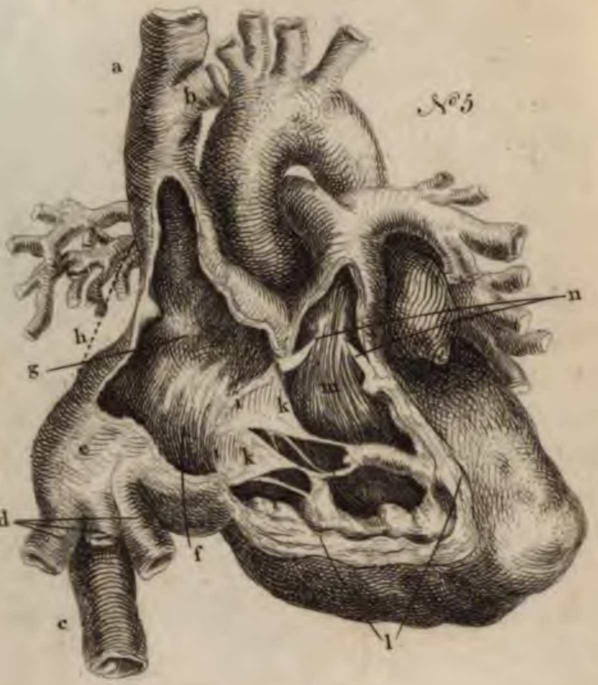
* Bartholini Epiſt. p. 107.

P. II

Plans of the Heart

№ 5



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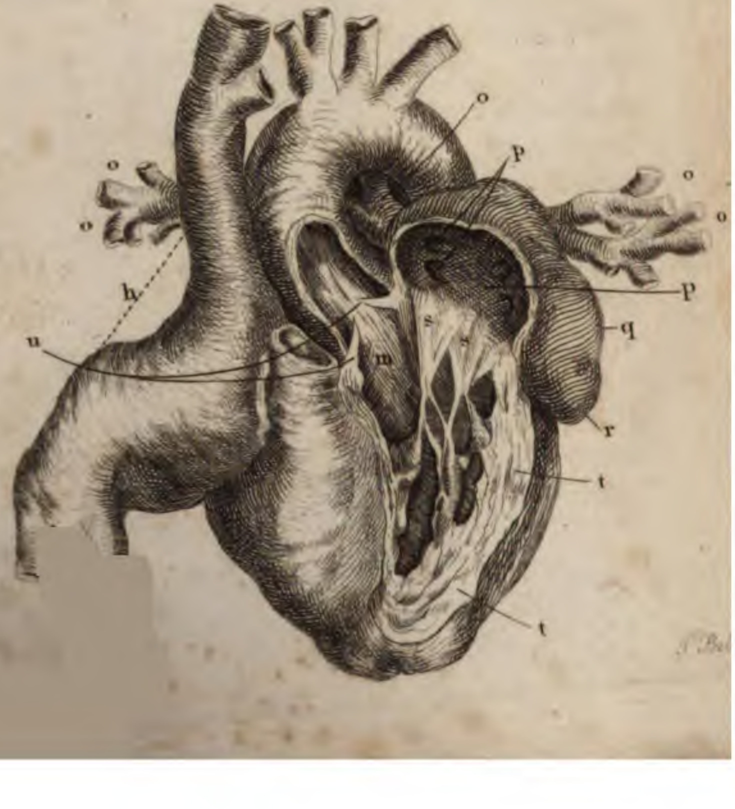

J. Bel

OF THE PARTS OF THE HEART.

As yet I have explained only the general plan of the circulation, without having deſcribed thoſe curious parts which are within the cavities of the heart, and which ſupport the actions in this beautiful harmony and perfect order, each part ſubordinate to ſome other part, and each action ſucceeding ſome other action with perfect correctneſs, often without one unſteady motion or alarming pauſe, during the courſe of a long irregular life.

1. The VENÆ CAVÆ are two in number *; they are named venæ cavæ from their very great ſize; the one brings the blood from the upper, and the other from the lower parts of the body, and they are formed of theſe branches: the upper vena cava *(a)* is properly termed the DESCENDING CAVA, becauſe it carries the blood of the head and arms downwards to the heart: this great vein is properly a continuation of the right jugular vein, which joins with the right axillary vein, and then deſcends into the cheſt a great trunk; and in the upper part of the cheſt it is joined at *(b)*—by a great branch, containing the axillary and jugular veins of the left ſide, which, in order to reach the cava, croſſes the

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* Let the reader obſerve, that the whole of this deſcription of the various parts of the heart is, as it were, an explanation of the plans N° 5. and 6.; of which the N° 5. ſhows the right ſide of the heart, or the heart of the lungs opened; while N° 6. ſhows only the left heart, or the heart of the body opened.

upper part of the cheſt, and lies over the carotid arteries. The LOWER VENA CAVA, or CAVA ASCENDENS, brings in like manner all the blood from the belly and lower parts of the body by two great branches. One, marked (*c*),—is the great vein which lies in the belly along the left ſide of the ſpine, and brings the blood from the legs, the pelvis, and parts of generation, the kidneys, &c.; it is named the VENA CAVA ABDOMINALIS, becauſe of its lying in the abdomen. Another, marked (*ddd*),—ariſes in three or four great branches from the liver; it is named the branches of the vena cava in the liver, or the VENA CAVA HEPATICA; and theſe two make up the lower cava; and the lower and the upper cavas now join themſelves at (*e*)—to form the right ſinus of the heart.

2. The RIGHT SINUS of THE HEART, marked (*e*), is of conſiderable extent; it is juſt the gradual dilatation of the two veins forming the auricle or reſervoir, which is inceſſantly to ſupply the heart; the veins grow ſtronger as they approach the ſinus, and the ſinus ſtill ſtronger as it approaches the AURICLE or notched and pendulous part (*f*), and the auricle again approaches in its nature to the ventricle of the heart; for it is croſſed with very ſtrong muſcular fibres, which make very deep riſings and furrows upon its inner part. To ſay that theſe veins, or the ſinus which they form, are not muſcular, merely becauſe they are not red nor fleſhy, is very ignorant; for the ureters, urethra, arteries, inteſtines, the iris, and many other parts of the human body, are, at the ſame time, perfectly muſcular and perfectly pale; and the heart of a fiſh is as tranſparent as a bubble of water, and yet is ſo irritable,

that after it is brought from market, if you lay open the breaſt, and ſtimulate the heart with any ſharp point, it will renew its contractions, and in ſome degree the circulation.

3. The TUBERCULUM LOWERI ſhould be looked for in this point, if it were not really an imagination merely of that celebrated anatomiſt. The whole matter is this; the two veins meet, not directly, but at a conſiderable angle within the vein, as at (*g*). Lower conceived a projection of the inner coats of the vein at this point much more conſiderable than what I have here repreſented. It was thought to do the office of a valve, to break the force of the deſcending blood, to defend from preſſure that blood which is aſcending from the lower cava, and to direct the blood of the upper cava into the right auricle of the heart. But there is no ſuch thing; although anatomiſts were at one time ſo fond of this trivial obſervation, that not one of them would demonſtrate the heart, without demonſtrating the tuberculum Loweri; whereas, if the blood of the lower cava needs any ſcreen above it to defend it from the preſſure, it is (as I ſhall ſhow preſently) quite of another kind; and in the place appointed for finding this tuberculum Loweri we can find nothing but on the inſide the natural angle of the two veins, and on the outſide ſome fat cuſhioned up in that angle in the line (*h*).

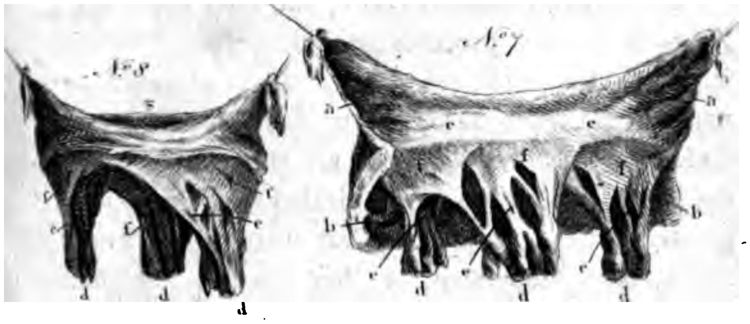
4. The AURICLE is, as I have ſaid, a ſmall appendix to the great bag or ſinus, and is marked (*f*). It is ſmall, ſemicircular, notched or ſcolloped, and ſomewhat like a dog's ear; whence its name. In general, we name the whole of this bag auricle; but

by this plan the names of ſinus and auricle muſt be eaſily underſtood. The point chiefly to be noted is this, that the veins, as they approach the auricle, are thin, delicate, tranſparent; that where they expand into the ſinus they become fleſhy, thick, and ſtrong; that in the auricle itſelf the muſcular fibres at (*f*) are very ſtrong, have deep ſulci like thoſe of the ventricle, croſs each other ſo as to make a net-work; and theſe ſtrong fibres (*f*) are what are named the muſculi pectinati auriculæ. Where theſe muſcles run, as in cords, acroſs the auricle, they are very thick and opaque; but in the interſtice of each ſtripe of muſcular fibre, the auricle is perfectly and beautifully tranſparent, like the membranes of the veins; and theſe ſtripes of muſcular fibre which are laid upon this thin membrane are almoſt as regular as the teeth of a comb; and thus they are named MUSCULI PECTINATI.

5. The VALVES of the AURICLE are placed at the circle (*i*), where the auricle enters into the ventricle, and the valves are marked (*k*): and how neceſſary theſe are for regulating the movements of the heart, will be eaſily underſtood by conſidering the conditions in which the auricle and ventricle act. Firſt, The cavas pour in a flood of blood upon the ſinus and auricle, with a continual preſſure; the moment the auricle has contracted, it is full again; the preſſure from behind excites it to act, and while it is acting there is no occaſion for valves to guard thoſe veins whoſe blood is preſſing forwards continually, becauſe they are continually full, and have behind them the whole preſſure of the circulating blood. But when the auricle acts, it throws its blood into the ventricle, fills it,

and ſtimulates it; the auricle then lies quieſcent for a moment, while it is gradually filling from behind with blood; but during this quieſcent ſtate the whole blood from the ventricle would ruſh back into it, were it not guarded by valves. The valves, then, which riſe whenever the ventricle begins to act, are of this kind: There is, firſt, a tendinous circle or hole, by which the auricle communicates with the ventricle. The opening is large enough to admit two or three fingers to paſs through it; it is ſmooth, ſeems tendinous, is

Auricular Valves



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Auricular Valves explained.

Fig. 7. ſhows the Auricle and Ventricle cut open, and the valve hanging in three great diviſions.—(*a*) Part of the inſide of the Auricle.—(*b*) Part of the inſide of the Ventricle.—(*c*) The Tendinous Circle from which the membrane of the valve ariſes.—(*d*) The Columnæ Carneæ.—(*e*) The Cordæ Tendineæ.—(*fff*) The three great diviſions of the Valve.——N° 8. ſhows the circle of the entrance of the Auricle ſtill entire; where—(*g*)—marks the entrance into the Auricle.—(*fff*) The three great diviſions of the Valve.—(*d*) The Columnæ Carneæ; and—(*e*) The Cordæ Tendineæ.

is plainly the place of union betwixt the auricle and ventricle, which are in the fœtus (in the chick, for example) diſtinct bags; and from all the circle of this hole ariſes a membrane, thin, and apparently delicate, but really very ſtrong; not divided into particular valves at this root or baſis, but as the membrane hangs down into the ventricle, it grows thinner, and is divided into fringes. How theſe fringes can do the office of valves is next to be explained. The tags and fringes of this membrane are actually tied to the inſide of the ventricle by many ſtrings, which being, like the valves, of a tendinous nature, are called CORDÆ TENDINEÆ, or tendinous cords; and theſe cords being attached to little proceſſes projecting from the muſcular ſubſtance of the heart, theſe proceſſes are named COLUMNÆ CARNEÆ, or fleſhy columns. Of theſe tyings of the valves there are three chief points; the whole circle ſeems to be divided into three ſharp pointed valves; they are named VALVULÆ TRICUSPIDES, or three-pointed, or they are ſtill ſometimes called Triglochine Valves. Theſe ſtrings and muſcles croſs each other; the valve at the left part of the circle is tied obliquely to the right ſide of the ventricle, and ſo on; ſo that by this croſſing of their tendons the valves fall down eaſily when the blood goes down through them, and they riſe readily and quickly whenever the blood gets behind them. The columnæ carneæ tie down the valves, ſo that when the ventricle acts the moſt ſtrongly, they are the moſt ſtrongly retained.

6. The VENTRICLE of the RIGHT SIDE (*ll*) is like its auricle, larger than the ſame parts on the left ſide;

for this auricle and ventricle of the right ſide have the weight of the whole blood of the body preſſing upon them. They are ſubject to occaſional fulneſs, for they muſt be dilated by many accidents, as labour, violent ſtruggles, &c. which ſend the blood too quickly upon the heart; while the left auricle and ventricle, on the other hand, can never be overloaded, as long as the pulmonic artery preſerves its natural ſize, for that artery continues always the meaſure of the quantity of blood which they receive. The ventricle is thick, ſtrong, and fleſhy. Its inner ſurface is extremely irregular; it puts out from every part of its ſurface very ſtrong fleſhy columns. Theſe fleſhy columns are irregular in ſize, big, ſtrong, running along the length of the ventricle; ſome croſs the ventricle, ſo as to connect its oppoſite walls together; ſome have the tendons of the valves fixed to them; all of them have perfect contractile power, and are indeed the ſtrongeſt muſcles of the heart. Betwixt the fleſhy columns, there are, of courſe, very deep and irregular grooves; and among the confuſed roots of theſe fleſhy columns the blood often coagulates after death, ſeldom before it, into the form of what are called polypi of the heart. Yet ſtill the walls of the right ventricle (*ll*)—are thinner, the fleſhy columns ſmaller, the cavity greater, than thoſe of the left ſide; the right ventricle of the heart has alſo a peculiar form, for the SEPTUM CORDIS, a partition betwixt the right and left heart, is not, as generally ſuppoſed, a part common to both; but the left ventricle is much longer, and more conical than the right one; the ſeptum belongs almoſt entirely to the left ventricle; the right ventricle, which is much bigger, laxer, flatter, and thinner in the walls, is, as it were, wrapped round the left; and thus the left ventricle alone forms the acute apex of the heart, and the left ventricle of neceſſity bulges very much into the cavity of the right, ſince the right ventricle is ſo much larger, and in a manner wrapped round it. In both ventricles, it is very remarkable, that towards the opening of the auricle the ſurface of the ventricle is very rugged, irregular, and croſſed with columnæ carneæ, while a ſmooth and even lubricated channel marked (*m*)—leads towards the artery.

7. The PULMONIC ARTERY ariſes from the right ventricle, to carry out the blood cloſe by the great opening at which the auricle pours it in; the artery riſes at its root in a very bulging triangular ſhape. It is the valve within the mouth of the artery that gives it this very peculiar ſhape without; for the bulging root is divided into three knobs, indicating the places of the three valves, the artery dilating behind each valve into a little bag, which, when it is deſcribed, is called its ſinus.

8. This VALVE of the PULMONIC ARTERY (*n*)—has a more perfect and ſimple form than that of the auricle. The valves in the mouth of each of the great arteries are three in number; they are thin but ſtrong membranes, riſing from the circle of the artery, where it comes off from the heart: each valve is ſemilunar; its larger and looſer edge hangs free into the cavity of the artery; the edge is a little thicker than the reſt of the valve; the three valves together form one perfect circle, which cloſes the mouth of the artery ſo that no groſſer fluid, nor hardly air can paſs.

When they are filled till they become very tenſe, each valve forms a kind of bag; ſo that when you look at the mouth of a dried artery, they appear like neat round bags; and when they are likely to be forced, the little horns or tags by which each valve is fixed into the coats of its artery, become ſo tenſe as to do the office of a ligament: theſe are called the SEMILUNAR OR SIGMOID VALVES.

Now the condition of the ventricle while it is contracting is well underſtood: the auricle by its action lays down the tricuſpid or auricular valve, and fills the ventricle; the ventricle cannot feel the ſtimulus of fulneſs till its valves riſe and its cordæ tendineæ begin to pull; and the ventricle could not be cloſe for acting, nor its walls perfect, it could not in ſhort be an entire cavity, till the tricuſpid or auricular valves were completely raiſed. But there is another opening of the ventricle, viz. that into the artery, which muſt be alſo ſhut; this is one of the ſeveral inſtances of the ſubordination of theſe actions one to another; for firſt the auricle acts, then the ventricle, then the artery; ſo that the auricle and the artery are acting in the ſame moment of time; the artery by acting throws down its valve, and cloſes that opening of the ventricle, while the auricle is filling it with blood; and again, the moment that the ventricle is filled, both the auricle and artery are in a ſtate of relaxation, both their valves yield, the auricular valve riſes ſo as to cloſe the ventricle on that ſide; and the arterial valve falls down, both becauſe the artery has ceaſed acting, and becauſe the valve is laid flat by the whole blood of the ventricle ruſhing through it. Hence it is very obvious, that the right ventricle could neither be filled nor ſtimulated, unleſs the opening toward the artery were cloſe during the time of its filling; and again, it is obvious that this valve cannot be laid down by any other power than that of the artery itſelf; who then can doubt that the artery has in itſelf (like the ventricle) a ſtrong contractile power? That it is the ſtroke of the artery ſucceeding that of the heart that lays down this valve ſo cloſely, is proved by this, that in many animals, the Frog for example, the aorta is as plainly muſcular as the heart itſelf, it is like a ſecond heart; and in many creatures, as in fiſhes, and often in human monſters, the artery alone, by its own muſcular power, moves the whole circulation without any communication with the heart. In fiſhes there is no ſecond heart for the circulation of the body; and in monſters the heart is ſometimes wanting, and there is found nothing but a ſtrong aorta to ſupply its place. This ſtroke of the pulmonic artery, then, (which the heart excites,) puſhes the blood through the leſſer circle or circulation of the lungs, and by the pulmonic veins it is poured into the left ſide of the heart.

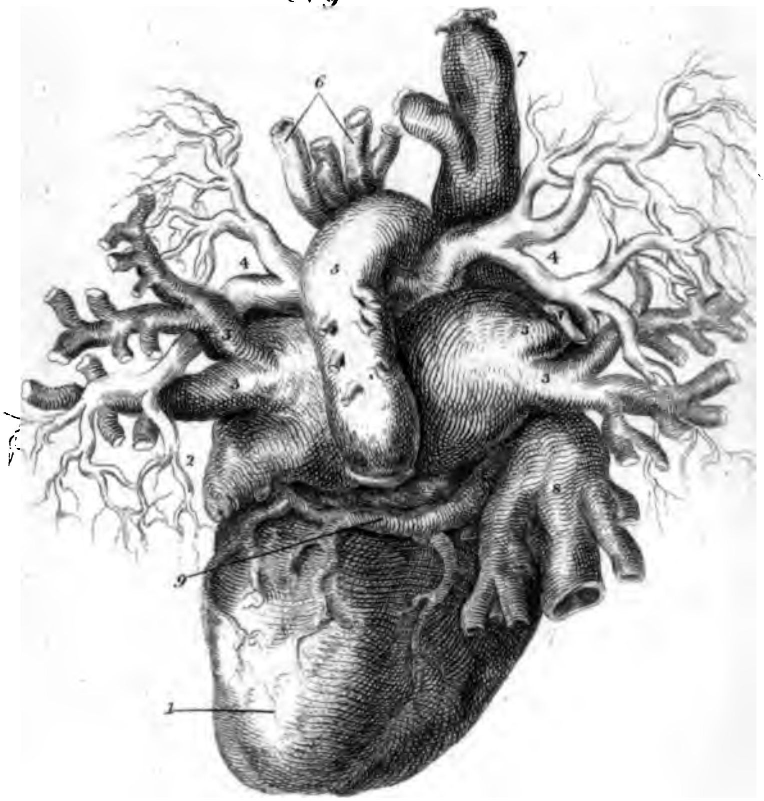
9. The LEFT AURICLE of the heart is unlike the right auricle in theſe reſpects: the ſinus, or that part which conſiſts of the dilatation of the pulmonic veins, is ſmaller, while the auricula, which is the more muſcular part, is larger; the pulmonic veins come in four great trunks from the lungs, two from the right ſide and two from the left; two great veins then enter at each ſide of the left auricle, by which it gets a more ſquare form; the whole of the left ſinus, which forms

the

Sketch

Representing the Backpart of the Heart — The great Coronary Vein —
The Shape of the left Auricle — and the entrance of the Pulmonary Veins

N°9



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the chief bulk of this part, is turned directly backwards towards the ſpine, and is not to be ſeen in any common view of the heart; but I have here added a plan of the back part of the heart *, ſhowing, 1. How the left ventricle lies behind; 2. How the left auricle is turned ſtill more directly backwards; 3. How the pulmonic veins enter into it in four great branches, ſo as to give a ſquare or box-like form, compared with the gliding, gentle ſhape of the right auricle; 4. How the pulmonic artery comes out from under the arch of the aorta, dividing into its two great branches for each ſide of the lungs; and, 5. How the aorta arches over it, towers above all the other veſſels, and is known always among the veſſels of the heart by the carotid and ſubclavian arteries which come off from its arch. On the plan, N° 6. are ſeen—(*oo*) the two pulmonic veins entering from each ſide of the lungs—(*pp*) the opening of theſe into the auricle—(*qq*) the ſinus formed in part by the dilatation of theſe veins, and—(*r*) the auricula or little ear, from which the whole bag is named auricle.

10. The valves which guard the left auricle are

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* Explanation of the BACK VIEW of the HEART, N° 9.

1, The left Ventricle—2, The left Auricle—3 3 3 3, The four Pulmonic Veins—4 4, The two great branches of the Pulmonic Artery—5, The Aorta—6, The Carotids and Subclavians—7, The Cava Deſcendens—8, The Cava Aſcendens, with all its branches from the Liver—9, The great Coronary Vein running along the back of the Heart betwixt the Auricle and Ventricle in a groove ſurrounded by fat.

ſeen here * (*ss*);—Now it is to be remembered that the left auricle is ſmaller than the right, that the circle or opening of the left auricle is of courſe ſmaller than that of the right; that while it requires a valve divided into three points to fill the opening of the right auricle, a valve divided only into two points ſuffices for the opening of the left auricle: this is the reaſon of this ſlight variety of ſhape betwixt the two auricular valves, and is alſo the reaſon of the valve of the right ſide being called TRICUSPID or three-pointed, while this of the left ſide, from ſome very ſlight reſemblance to a mitre, is named VALVULA MITRALIS, the MITRAL VALVE. In all other points this valve is the ſame with that of the right ſide, it has the ſame apparent thinneſs, for it is even tranſparent, the ſame real ſtrength, the ſame COLUMNÆ CARNEÆ and tendinous ſtrings to ſupport it; the ſame rough irregular ſurface towards the opening of the auricle; the ſame ſmooth gutter leading towards the artery. The conſtitution of all theſe parts, in ſhort, is expreſsly the ſame; ſo that even concerning the left ventricle there is nothing further to be obſerved, but that while it is much longer than the right ventricle, it is much ſmaller in its whole cavity, is much ſtronger in its COLUMNÆ CARNEÆ, and much thicker in its fleſhy walls, as at (*tt*)—Where it is ſeen to be thicker than the right ventricle, it is indeed nearly three times as thick.

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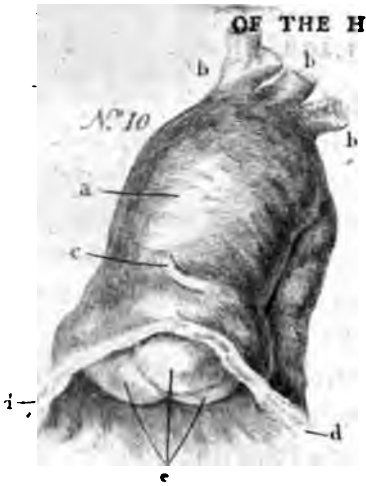
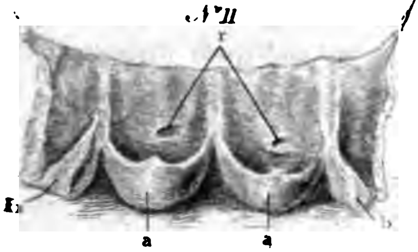
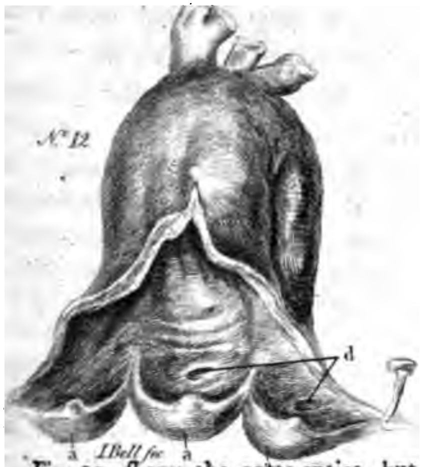
* This begins the deſcription of the left ſide of the Heart, and the deſcription follows the Plan, N° 6.







11. The SEMILUNAR VALVES of the aorta are alſo ſeen in this general plan at (*u*) — where manifeſtly the general ſtructure and general intention of the valves are the ſame as in thoſe of the pulmonic artery; but ſtill we find at every point marks of ſuperior ſtrength and more violent action in the left ſide of the heart; for though this valve be expreſsly like that of the pulmonic artery, and named like it ſemilunar, yet it is thicker and ſtronger in its ſubſtance, and is peculiarly guarded by three ſmall hard tubercles, which being placed one in the apex or point of each valve,

Fig. 10. ſhows the aorta entire, but its root within the heart opened ſo as to ſhow its valve — (*a*) The body of the aorta; the arch is

valve, meet together when the valve is cloſe, and give a more perfect reſiſtance to the blood, and prevent the valve being forced open. Theſe are to be ſeen chiefly in the marginal drawing, and from their being of the ſize of ſeſamum ſeed, they have the name of CORPORA SESAMOIDEA; ſometimes they are named Corpuſcula Aurantii.

12. The AORTA ariſes from its ventricle very large and ſtrong; it ſwells ſtill more at its root than the pulmonic artery does; the three ſubdiviſions of this ſwelling, which mark the places of the ſemilunar valves, are very remarkable; the curvature at the arch of the aorta is called its great ſinus, and theſe three ſmaller bags are called the three leſſer ſinuſes of the aorta.

Of the CORONARY VESSELS.

But there ſtill remains to be explained that peculiar circulation by which the heart itſelf is nouriſhed, and yet there is nothing in it very different from the uſual form of arteries and veins; it is a part of the general circulation of the body, for the heart is nou-

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is marked by *bb*, the carotids and ſubclavians—(*c*) Shows one of the coronary arteries or artery of the heart.—(*d*) A part of the walls of the heart.—(*eee*) The three valves ſtuffed and turgid towards the heart.—— N° 11. ſhows the lower part of the aorta cut open; and two of the valves—(*aa*)—entire; and the third valve—(*bb*)—cut in two by ſlitting up the artery.—And (*rr*) ſhows the mouths of the two coronary arteries.——N° 12. ſhows the aorta ſlit only in its lower part, and the valves (*aa*) and the mouths of the coronary arteries (*bb*) are ſeen in their natural ſituation.—*N. B.* In theſe two laſt drawings the corpora ſeſamoidea are diſtinctly ſeen in the central part of the edge of each valve, and they need no letter to diſtinguiſh them.

riſhed by the two firſt branches which the aorta gives off. The circulation deſtined for the nouriſhment of the heart is peculiar in this chiefly, that the forms of the arteries and veins of the heart are beautiful, and that the arteries riſe juſt under the valves of the aorta, while the veins end with one great mouth in the right auricle. The coronary arteries are two in number, of the ſize of crow-quills; we ſee from the inſide of the artery their mouths opening under the ſigmoid valves. One artery comes from the lower ſide of the aorta; it lies towards the right; it belongs chiefly to the right ventricle; it comes out firſt betwixt the roots of the aorta and pulmonic arteries; it paſſes in the furrow betwixt the right ventricle and auricle, and turning round arrives at the back part of the heart, and runs down along the middle of that flat ſurface which lies upon the diaphragm; and when it arrives at the apex of the heart, its extreme arteries turn round the point and inoſculate with the oppoſite coronary. The other coronary belongs in like manner to the left ſide of the heart, and ariſes from the upper ſide of the aorta; it firſt goes out betwixt the pulmonic artery and the left auricle, and then turning downwards upon the heart, it runs along that groove which is betwixt the ventricles, and marks the place of the partition or ſeptum ventriculorum; its chief branches turn towards the left ventricle, and branch out upon it; it belongs as peculiarly to the left ſide of the heart as the other does to the right ſide: after ſupplying the left ventricle, &c. it turns over the point of the heart to meet the extremity of the firſt, and inoſculate with it. Both theſe arteries give branches not only to the fleſh of the heart, but alſo to the roots of the great arteries, conſtituting the VASA VASORUM, as ſuch veſſels are called.

The GREAT CORONARY VEIN which collects the blood of theſe arteries, ariſes in ſmall branches all over the heart; theſe meet ſo as to form a trunk upon the fore-part of the heart, where the ſeptum or union of the ventricles is. While ſmall, the veins accompany their reſpective arteries; but after the great trunk is formed, the vein takes its own peculiar route. When the trunk of the great coronary vein (accompanied by ſeveral leſſer veins) arrives at the auricle, it runs in between the left auricle and left ventricle; it turns all round the back of the auricle till it gets to the right ſide of the heart; it lies in the deep groove betwixt the auricle and ventricle, ſurrounded with much fat; and having almoſt entirely encircled the heart, it diſcharges its blood into the right auricle, cloſe by the entrance of the lower cava. The opening is very large; it lies juſt above the tendinous circle of the auricle, and it is guarded with a ſtrong ſemilunar valve. This is the great coronary vein: all the veins which appear upon the heart are but branches of it; what are called the MIDDLE vein of the heart, the vein of the right auricle, the vena innominata, &c. are all but branches of the great coronary vein running along the right ſide or lower ſurface of the heart; if there were to be any marked diſtinction, it ſhould be into the GREAT CORONARY VEIN belonging to the left ſide of the heart, and the VENA INNOMINATA belonging to the right ſide. But one thing more is to be obſerved; viz. that upon the inner ſurface of the right auricle may be ſeen many ſmall oblique and very curious openings, which ſerve for the mouths of veins, while their obliquity performs the office of a valve. This name of coronary veſſels is a very favourite one with anatomiſts, and is applied wherever veſſels ſurround the parts which they belong to, however little this encircling may be like a crown; and it is thus that we have the coronary arteries of the ſtomach, coronary arteries of the lips, and coronary arteries of the heart. But theſe veſſels of the heart are really very beautiful, and have ſome things very peculiar in their circulation: firſt, with regard to the coronary arteries, they lie with their mouths under the ſigmoid valves; or at leaſt in ſo equivocal a manner, that their peculiar poſture has given riſe to violent diſputes; viz. Whether they be filled, like all the other arteries, by the ſtroke of the heart, or whether they be covered by the valve ſo as to let the blood ruſh paſt them during the action of the heart.

We ſee the opening of the coronary arteries rather, as I imagine, under the valve; though Haller ſays they are above the valve, and that the higheſt point to which the margin of the valve reaches in very old men is below the opening of the coronary artery, and half way betwixt it and the bottom of the ſinus or little bag behind the valve. But let this be as it will, if the condition of the aorta be conſidered, it will be found to make no difference; for though the valves riſe and fall, are at one time fully opened, and at another time cloſely ſhut, ſtill in both theſe conditions of the valve the aorta is as full as it can hold; its contraction inſtantaneouſly follows that of the heart, but its contraction is not, like that of the heart, ſuch as to bring its ſides together; on the contrary, the aorta is full when the heart ſtrikes, the action of the heart diſtends it to the greateſt degree, the aorta reacts ſo as to free itſelf of this diſtention, but ſtill it remains in ſome degree full of blood; elſe how could this, like every other artery, preſerve always its form and apparent ſize? In this condition of matters, it is obvious that the coronary branches are on the ſame footing with all the other branches of the aortic ſyſtem; that, like all the other arteries, they firſt feel the ſtimulus of fulneſs from the puſh of the heart, and along with it the ſtroke of the aorta.

Secondly, with regard to the coronary veins a diſpute has ariſen more violent than this; for it has been doubted whether the coronary veins, large as they are, do actually convey the whole of the blood which the coronary artery gives out. Veuſſens believed that ſome of the coronary arteries opened directly into the cavities of the heart, without the interpoſition of veins. Thebeſius, after him, believed that there were ſome ſhorter veins by which the blood was returned, not by a long circle into the right auricle, but directly into the ventricles of the heart. Veuſſens, Thebeſius, and others who belonged to their party, pretended to prove this fact by injections: But what doctrine is there which ſuch clumſy anatomy and awkward injections may not be made to prove? They uſed mercury, tepid water, and air; and they forced theſe, the moſt penetrating of all injections, till they exuded upon the inner ſurface of the heart; but if they had fixed their tubes, not into the coronary artery, but into the aorta, and had proceeded to inſpect, not the heart, but all the viſcera of the body, they would have found their injections exuding from every ſurface; of the pleura, and lungs; of the peritoneum, and inteſtines; of the brain, and dura mater; of the mouth, and tongue; and univerſally through the cellular membrane of the whole body; but if any coarſe injection, as tallow or wax, be uſed, it does not exude this way, but, following its natural courſe, keeps within the arteries and veins, and ſometimes finds its way back to the auricle of the heart.

Du Verney was ſo far engaged in this queſtion, that having an opportunity of diſſecting the heart of an elephant, he tied up the coronary arteries and veins, waſhed and cleaned very thoroughly the cavities of the heart; and then tried, by ſqueezing, and all kinds of methods, to make that blood which was tied up in the coronary arteries and veins exude upon the inner ſurface of the heart, but with no effect.

On the preſent occaſion, a theoretical anſwer happens to be as ſatisfactory as the moſt correct experiments; and it is this, If there really were to be formed (by diſeaſe for example) thoſe numerous openings which Thebeſius and Veuſſens deſcribe, then the blood flowing all by theſe ſhorter and eaſier paſſages, none could come to the great coronary vein; its office would be annihilated, and itſelf, contracting gradually, would ſoon ceaſe to exiſt.

Of the EUSTACHIAN VALVE.

There remains to be explained in the mechaniſm of the heart one point; and which I have ſeparated from the others; not becauſe it is the leaſt important, but becauſe it is the moſt difficult, and, if I may be allowed to ſay ſo, not yet thoroughly underſtood; I mean the anatomy of the EUSTACHIAN VALVE; which, if it had been eaſily deſcribed, ſhould have been firſt deſcribed; for it is a valve which lies in the mouth of the lower cava juſt where that vein enters the right auricle of the heart. How imperfect a valve this is, how difficult to diſſect or to explain, may eaſily be known from this, that Winſlow was firſt incited to look for the valve by ſome hints in Sylvius; he was ſoon after fairly directed to it by finding it in the tables of the Euſtachius, which were then firſt found and publiſhed by Lanciſi, after the author had been dead 150 years; and yet with all this aſſiſtance Winſlow ſought for it continually in vain, till at laſt he reflected, that by cutting the heart in its fore-part he muſt have always in his diſſections deſtroyed any ſuch valve: by opening the back part of the cava he at laſt ſaw the valve, and demonſtrated it to the Academy of Sciences in France; and having juſt received from Lanciſi his edition of the Euſtachian Table, ſo long hidden, and ſince ſo outrageouſly praiſed, he called it VALVULA EUSTACHIANA, a name which it has retained to this day, and he added RETICULARIS to expreſs its lace-like netted appearance at its upper edge. From Winſlow's time to this preſent day, that is, for eighty years, there has been no good drawing, nor even any perfect deſcription of the valve; and, in the confuſion of opinions upon the ſubject, what its uſe may be no one knows.

The Euſtachian valve lies in the mouth of the aſcending cava, juſt where that great vein is joined to the auricle of the heart. It looks as if formed merely by the vein entering at an acute angle, and by the inner edge of the vein, or that which is joined to the auricle, riſing high, ſo as to do the office of a valve. The very firſt appearance of the valve, and its place juſt over the mouth of the cava, ſeems to point out that uſe which Lanciſi has aſſigned it, viz. to ſupport the blood of the upper cava, and prevent that column of blood which deſcends from the cava gravitating upon the oppoſite column which comes from the liver and lower parts of the body; and yet this, moſt likely, is not its uſe. The valve ſomewhat reſembles a creſcent, or the membrane called hymen. It occupies juſt that half of the cava which is neareſt the auricle. Its deepeſt part hangs over the mouth of the cava, and is nearly half an inch in breadth, ſeldom more, often leſs, ſometimes a mere line. Its two horns extend up along the ſides of the auricle; the poſterior horn ariſes from the left of the iſthmus, as it is called, or edge of the oval hole; its anterior horn ariſes from the vena cava, where it joins the auricle. Behind the valve the remains of the foramen ovale may be ſeen, now ſhut by its thin membrane, but ſtill very eaſily diſtinguiſhed; for its arch-like edges are ſo thick, ſtrong, and muſcular, that they look like two pillars, and thence are called the COLUMNÆ FORAMINIS OVALIS: theſe two pillars were called ISTHMUS VIESSENII, and by Haller are named ANNULUS FOSSÆ OVALIS, while the hole itſelf is ſo deep that it is named the FOSSA OVALIS. Before the Euſtachian valve lies the great opening into the ventricle; but betwixt that and the valve there is a foſſa or hollow, in which lies the opening of the great coronary vein; and the valve which covers the coronary vein is a neat ſmall ſlip of white and very delicate membrane, the one end of which connects itſelf with the fore-part of the Euſtachian valve; ſo that both valves are moved and made tenſe at once.

The Euſtachian valve is in general thick and fleſhy; it is ſometimes reticulated or net-like even in the fœtus, but by no means ſo often as to vindicate Winſlow, in adding reticulare to the name; it grows reticulated chiefly in the adult. The only beautiful drawing that we have of a reticular Euſtachian valve is in Cowper; and that was from a man of eighty years of age. Perhaps in eight or ten hearts you will not find one that is reticulated in the leaſt degree; in old men it is reticulated, juſt as all the other valves of the heart are, not by any thing peculiar to the conſtitution of this valve; not by the preſſure of the blood and continual force of the veſſels, as Haller repreſents; but by the gradual abſorption which goes on in old age, and which ſpares not the very bones, for even they grow thin and in many places tranſparent.

This is the ſimple deſcription of a valve, which has been the occaſion of more controverſy than the circulation of the fœtus and the uſe of the oval hole. Winſlow firſt began about eighty years ago to obſerve the connections and uſes of this vale: he laid it down as an abſolute fact that this valve was almoſt peculiar to the fœtus; that it was perfect only while the foramen ovale was open; that it vaniſhed gradually as the foramen ovale cloſed; that in the adult it was ſeldom ſeen unleſs the foramen ovale was alſo open by chance. It is incredible what numbers of anatomiſts followed this opinion; for the difficulty of diſſecting the valve made it always eaſier to ſay that it was only in the fœtus that it could be found: it is alſo incredible what abſurd conſequences aroſe from this doctrine, which, after all, is but a dream, for in fact the valve is more eaſily ſhown in the adult heart *.

The foundation being now laid for connecting this valve with the peculiar circulation of the fœtus, they conceived the following theory, which has come down to this very day; viz. that in the child the great object of nature, in arranging its veſſels, was to convey the blood which came freſh from the mother's ſyſtem directly into the carotids, and ſo plump into the head at once. The pure blood from the mother comes through the liver by the ductus venoſus; it is depoſited in the lower cava at the right ſide of the heart; and theſe anatomiſts ſuppoſed that this current of freſh blood was directed by the Euſtachian valve into the oval hole, through that into the left auricle and ven-

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* One author, I find in the Acta Vindobonenſia, is exceedingly angry indeed with all the great anatomiſts, for not connecting more ſtrictly with each other the anatomy and accidents of the foramen ovale, and Euſtachian valve; with Morgani, Albinus, and Wiedbriecht, he is offended for ſaying that they had ſeen the foramen ovale open, without ſaying one word concerning the ſtate of this valve; and with Lieuteaud, Portal, and others again, he is equally offended that they ſhould have had opportunities of ſeeing the Euſtachian valve entire without inquiring into the condition of the oval hole. The reaſon of all this is very plain; the oval hole had not been open, neither in the one ſituation nor in the other, elſe it is very unlikely that ſuch correct and anxious anatomiſts ſhould have deſcribed that valve which ariſes from one of the borders of the oval hole, without obſerving it open, if it was ſo; eſpecially as the oval hole, being open, is by no means an uſual occurrence.

tricle, and from theſe directly into the aorta and carotids; while the foul blood of the upper cava went down into the right auricle and ventricle, and from that into the ductus arterioſus, and ſo away down to the lower and leſs noble parts of the body, and to the umbilical arteries, and ſo out of the ſyſtem; for the ductus arterioſus, which comes from the right ventricle in the fœtus, joins the aorta only as it goes down the back, and none of its blood can paſs upwards into the head.

This is the puerile theory, which, modified in various ways, has amuſed the French Academy, or rather been the cauſe of a perpetual civil war in it, for a hundred years. This doctrine began with Winſlow, it is ſtill acknowledged by Sabbatier; and Haller, after announcing a theory not at all differing from this, challenges it as his own theory; "hanc meam conjecturam etiam a Nichols video proponi." Of the truth of this theory Haller was ſo entirely ſatisfied, that he not only publiſhed it as peculiarly his own, but reclaimed it when he thought it in danger of being thus appropriated by another. Sabbatier is the laſt in this train of authors; and in order that there might remain no ambiguity in what they had ſaid or meant, he pronounces plainly that the Euſtachian valve is uſeful only in the fœtus, and that there are two oppoſite currents in the right auricle of the heart; that the one goes from the lower cava upwards to the foramen ovale, while the other from the upper cava deſcends right into the opening of the ventricle. What ſhall we ſay to anatomiſts who in the narrow circle of the auricle conceive two currents to croſs each other directly, and to keep as clear of each other as the arrows by which ſuch currents are uſually repreſented. This error in reaſoning is below all criticiſm; it carries us backwards a hundred years in anatomy and in phyſics; and yet this is all that Winſlow, Haller, Sabbatier, and a mob of others, have been able to ſay in proof of the connection of the Euſtachian valve with the circulation of the fœtus.

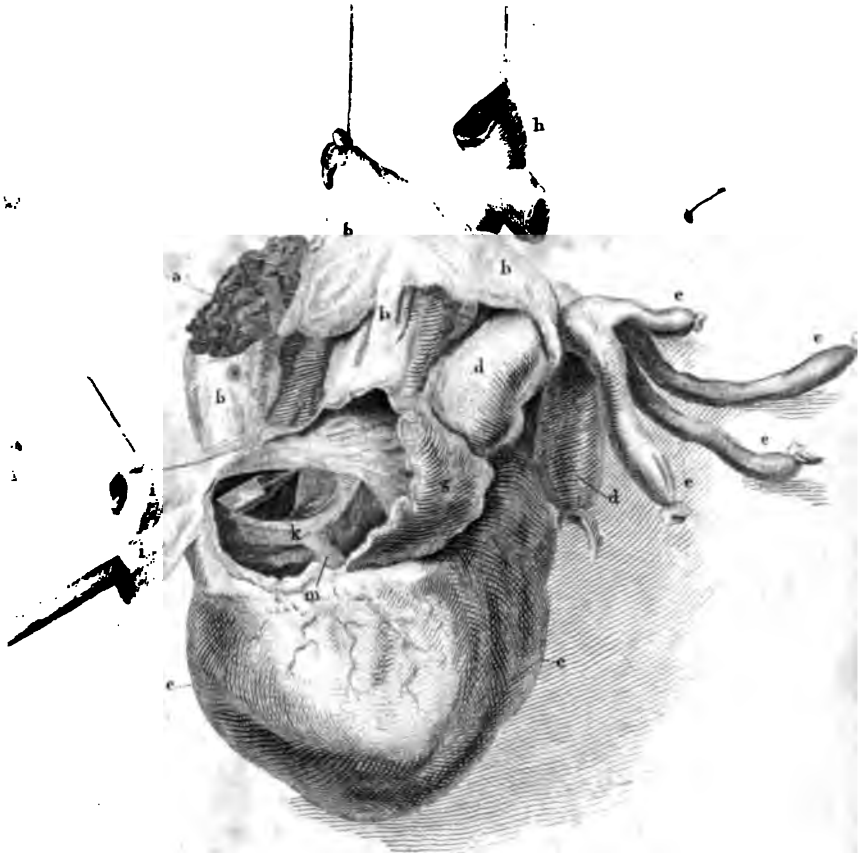
Lanciſi, again, believed that it was chiefly uſeful by ſupporting the blood of the lower cava, defending it from the weight of that column of blood which is continually deſcending from above; and Winſlow and others approved of this, as being perhaps one uſe of the valve. But they have all of them forgotten a little circumſtance, which muſt affect the office of the valve, and which ſhould have been regarded eſpecially by thoſe who ſaid it was uſeful chiefly before birth; they have forgotten a little circumſtance, which John Hunter alſo forgot, when theoriſing about the gubernaculum teſtis, viz. that the child lies with its head downmoſt for nine months in the mother's womb.

Nothing is more certain than that the Euſtachian valve is not peculiar to the fœtus; that it has no connection with the oval hole; that the valve is often particularly large after the foramen ovale is cloſed; that the valve is often obliterated where yet the foramen ovale remains open; that in adults it is more eaſily demonſtrated than in children; that in old age it is often reticulated as the other valves are. Its uſe relates neither to the foramen ovale, nor to the aſcending cava; it relates to the auricle itſelf, and therefore it is found in all the ſtages of life, ſmaller or larger according to the ſize or form of the heart.

The auricle on the ſide towards the venæ cavæ is imperfect; the anterior part of the auricle chiefly is muſcular, and when it contracts, the laxity of the cavas and the great width of the SINUS VENOSUS, *i. e.* of almoſt the whole auricle, would take away from its contraction all effect; but to prevent this, and to make the auricle perfect, the vena cava and auricle meet ſo obliquely, that the ſide of the cava makes a ſort of wall for the auricle on that ſide. This wall has entirely and diſtinctly the reticulated ſtructure of the auricle itſelf, with fleſhy bands of muſcular fibres in it: this wall falls looſely backwards when the auricle is quite relaxed, as, for example, when we lay it open; and thus it has got the appearance and name without the uſes of a valve; but when the heart is entire, tenſe, and filled with blood, this valve repreſents truly a part of the ſide of the auricle: and that this part of the wall of the auricle ſhould be occaſionally a little higher or lower, looſer or tenſer, we need not be ſurprized. This further may be obſerved, that wherever, as in a child, this valve is very thin and delicate, the anterior part of the foſſa ovalis goes round that ſide of the auricle particularly deep and ſtrong. Let it alſo be remembered, that in certain animals this valve is particularly large and ſtrong; now, in a creature which goes chiefly in a horizontal poſture, it may ſtrengthen and make up the walls of the auricle (the chief uſe which I have aſſigned for it in man); but ſurely it cannot protect the blood of the lower cava from the weight of blood coming from above, ſince the

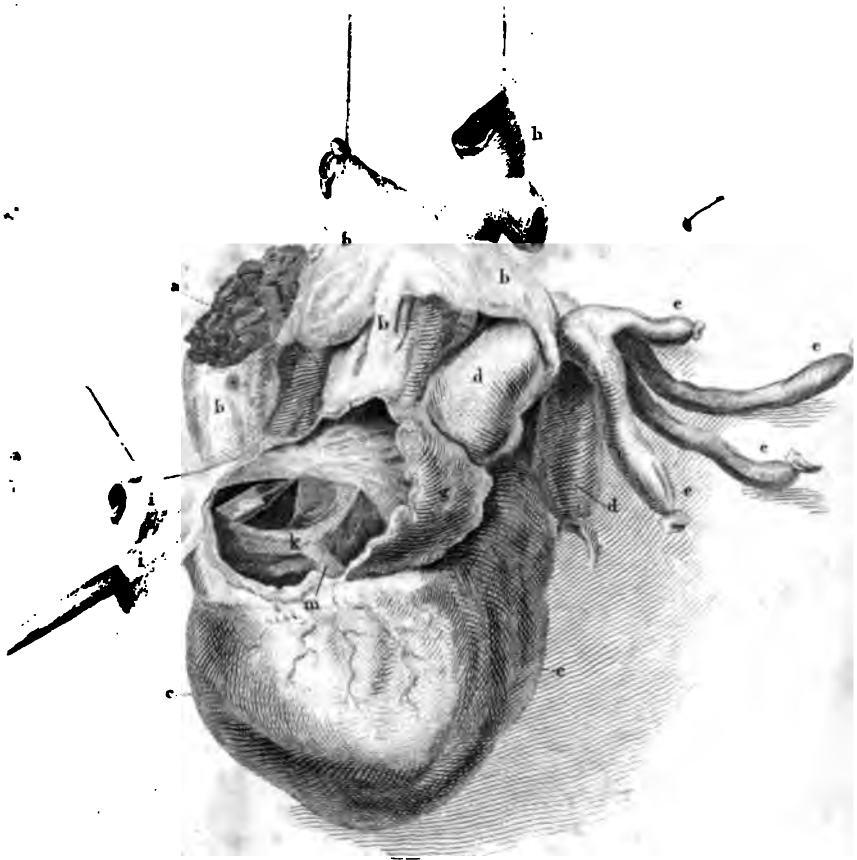
P. 37.

Drawing of the Eustachian Valve
from the heart of a Child
about 3 or 4 years old



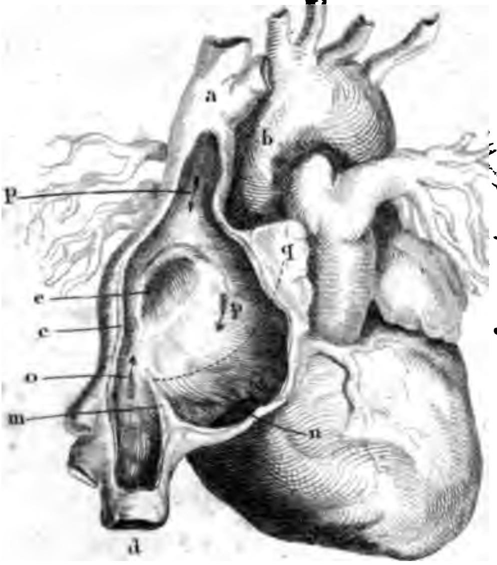
a.. Part of the Lungs. **bb.** The Pericardium by which the Heart is suspended. **cc..** The Ventricles of the Heart. **dd.** The Aorta encircled by the Pericardium. **eeee..** The Subclavian and Carotid Arteries. **g** The Pendulous part of the Right Auricle. **h.** The Cava descendens by which the Heart is in part suspended. **ii.** The Cava ascendens with a pencil passed up into the Right Auricle, this pencil is behind the Eustachian Valve. The Eustachian Valve itself is marked **k.** The little Valve of the Coronary Vein which is connected with it is marked **m.**

Drawing of the Eustachian Valve
from the heart of a Child
about 3 or 4 years old



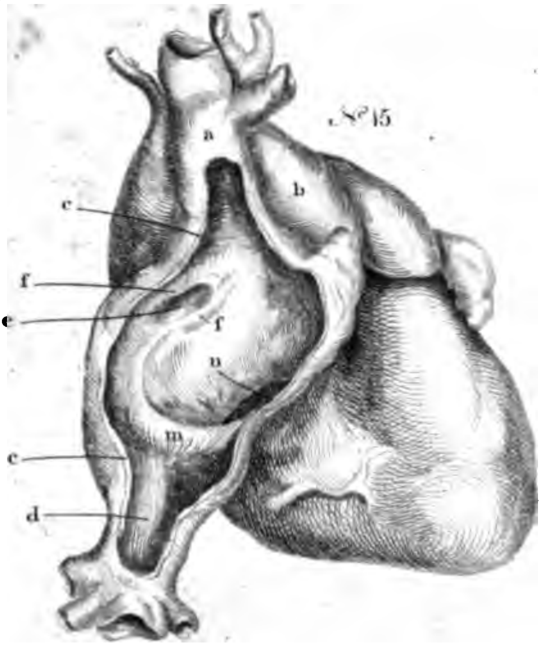
a.. A part of the Lungs. **bb.** The Pericardium by which the Heart is suspended. **cc..** The Ventricles of the Heart. **dd.** The Aorta covered by the Pericardium. **eeee..** The Subclavian and Carotid Arteries. **g** The Pendulous part of the Right Auricle. **h.** The Cava descendens by which the Heart is in part suspended. **ii.** The Cava ascendens with a pencil passed up into the Right Auricle. this pencil is behind the Eustachian Valve. The Eustachian Valve itself is marked **k.** The little Valve of the Coronary Vein which is connected with it is marked **m.**

Plans of the Eustachian Valve



N°14

N°15



the body of an animal lies horizontally, and there is no ſuch weight. The Pariſian academicians deſcribe the heart of the Caſtor in the following terms: "Under the vena coronaria we find the valve called nobilis (viz. the Euſtachian valve), which fills the whole trunk of the vena cava, and which is ſo diſpoſed that the blood may be eaſily carried from the liver to the heart by the vena cava, but which is hindered from deſcending from the heart towards the liver through the ſame vein*."

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* EUSTACHIAN VALVE.

N° 14. explains merely the place of the Euſtachian valve, which is ſeen at (*m*.)—N° 15. explains both the place of the valve and its relation to the oval hole (*e*)—behind it, and to the mouth of the ventricle (*n*)—which lies before it.

In both theſe plans—(*a*) Is the cava deſcendens—(*b*) The aorta riſing behind it—(*c c*) The back of the auricle ſlit open—(*d*) The cava aſcendens, in the mouth of which the valve is—(*e*) The foramen ovale—(*f f*) Its two riſing borders, named pillars, iſthmus of Veuſſens, annulus ovalis, &c.—(*m*) The Euſtachian valve, of which the two cornua, or ſharp points, are ſeen in the lower plate, terminating in the pillars of the foramen ovale on one hand, and in the walls of the auricle on the other. The opening of the foramen ovale (*e*)—is behind and above the valve; the opening into the right ventricle (*n*)—is before and under the valve.

N° 14. explains more particularly the uſes of the valve. Some authors conceived that it directed the blood riſing in the line (*o*)—upwards into the oval hole; others that it directed the column of blood, repreſented by the arrow (*p*)—into the right ventricle; others that it protected the column (*o*)—from the weight of the column (*p*).—I rather ſuppoſe that it completes the auricle in the direction of the dotted line (*q*)—and ſo ſtrengthens its action.

Of the IRRITABILITY and ACTION of the HEART.

But even this curious mechaniſm of the heart is not more wonderful than its inceſſant action, which is ſupported by the continual influx of ſtimulant blood, and by its high irritability and muſcular power; for though we cannot directly trace the various courſes of its muſcular fibres, there is not in the human body any part in which the muſcular ſubſtance is ſo denſe and ſtrong. In the heart there can be no direct or ſtraight fibres; for let them go off from the baſis of the heart in what direction they may, ſtill as they belong to the one or the other ventricle, they muſt, by following the courſe and ſhape of that ventricle, form an oblique line. Veſalius has indeed not repreſented them ſo, he has drawn ſtraight fibres only; becauſe in the latter end of his great work he was without human ſubjects, and betook himſelf to drawing from beaſts.

The fibres of the heart are all oblique, or ſpiral, ſome lying almoſt tranſverſe; they all ariſe from a ſort of tendinous line which unites the auricle to the ventricle; they wind ſpirally down the ſurface till the fibres of the oppoſite ventricles meet in the ſeptum and in the apex of the heart. The fibres of each ventricle paſs over the convex or upper ſurface of the heart, then over the apex, and then aſcend along the flat ſide of the heart, which lies upon the diaphragm, till they again reach the baſis of the heart, The ſecond layer or ſtratum of fibres is alſo oblique; yet many of the fibres run almoſt tranſverſely, uniting the oblique fibres; but when we go down into the thick ſubſtance of the heart, we find its fibres all mixed, croſſed, and reticulated in a moſt ſurpriſing manner; ſo that we at once perceive both that it is the ſtrongeſt muſcle in the body, and that the attempt to extricate its fibres is quite abſurd *. Their deſire of giving more correct and regular deſcriptions has been the cauſe why thoſe who have particularly ſtudied this point have been fatigued and diſappointed; the moſt ſenſible of them have acknowledged with Veſalius, Albinus, and Haller, that the thing could not be done; while thoſe, again, who pretended to particular accuracy, and who have drawn the fibres of the heart, have repreſented to us ſuch extravagant, groſs, and prepoſterous things, as have ſatisfied us more than their moſt ingenuous acknowledgments could have done, that they alſo could accompliſh nothing.

There is no queſtion that irritability is variouſly beſtowed in various creatures, that it is variouſly appointed in various parts of the body, that this property riſes and falls in diſeaſe and health; without heſitation we alſo may pronounce that the heart is in all creatures the moſt irritable part; it is the part firſt to live and the laſt to die: "Pulſus et vita pari ambulant paſſu." When we ſee the punctum ſaliens in the chick, we know that there is life; and when we open either the human body or the body of an animal ſoon after death, ſtill the heart is irritable and contracts.

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* Thickening the walls of the heart by vinegar, ſtrong acids, alum, or boiling the heart, have aſſiſted us in unravelling its ſtructure but very little.

In the very firſt days in which the heart appears in the chick, while yet its parts are not diſtinguiſhed, and the punctum ſaliens is the only name we can give it, the heart, even in this ſtate, feels the ſlighteſt change of heat or cold; it is rouſed by heat, it languiſhes when cold, it is excited when heated again. It is ſtimulated by ſharp points or acids, it works under ſuch ſtimuli with a violent and perturbed motion. In all creatures it ſurvives for a long while the death of the body; for when the creature has died, and the breathing and pulſe have long ceaſed, and the body is cold, when the other muſcles of the body are rigid, when the ſtomach has ceaſed to feel, when the bowels which preſerve their contractile power the longeſt have ceaſed to roll, and they alſo feel ſtimuli no more, ſtill the heart preſerves its irritability; it preſerves it when torn from the body and laid out upon the table; heat, cauſtics, ſharp points, excite it to move again.

We know alſo another thing very peculiar concerning the irritability of this organ, viz. that it is more irritable on its internal than on its external ſurface; for if inſtead of cutting out the heart we leave it connected with the body, ſeek out (as the old anatomiſts were wont to do) the thoracic duct, or pierce any great vein, and blow a bubble of air into the heart, it purſues it from auricle to ventricle, and from ventricle to auricle again, till, wearied and exhauſted with this alternate action, it ceaſes at laſt, but ſtill new ſtimuli will renew its force.

Thus it is long after apparent drowning or other ſuffocation before the principle of life is gone; and long after the death of the body before the heart be dead; and juſt as in this peculiar part of the ſyſtem irritability is in high proportion, there are in the ſcale of exiſtence certain animals endowed in a wonderful degree with this principle of life. They are chiefly the amphibious creatures, as they are called, needing little air, which have this power of retaining life; no ſtimuli ſeem to exhauſt them, there ſeems eſpecially to be no end to the action of their heart; a Newt's or a Toad's heart beats for days after the creature dies; a Frog, while uſed in experiments, is often neglected and forgotten, its limbs mangled, and its head gone, perhaps its ſpinal marrow cut acroſs, and yet for a whole night and a day its heart does not ceaſe beating, and continues obedient to ſtimuli for a ſtill longer time. It ſeems as if nothing but the loſs of organization could make this irritable muſcle ceaſe to act; or rather it ſeems as if even ſome degree of deranged organization could be reſtored: breathe upon a heart which has ceaſed to act, and even that gentle degree of heat and moiſture will reſtore its action. Dr. Gardiner having left a Turtle's heart neglected in a handkerchief, he found it quite dry and ſhrivelled, but by ſoaking it in tepid water its plumpneſs and contractility were reſtored.

Since then this irritable power ſupports itſelf in parts long after they are ſevered from the body, what doubt ſhould we have that there is in the muſcular fibre ſome innate contractile power or vis inſita independent of nerves? And when we talk on a ſubject ſo difficult and ſo abſtruſe, what other proof can we expect or wiſh for than the power of one peculiar and inſulated muſcle ſurviving the ſeparation of the head and brain, the deſtruction of its nerves, or its total ſeparation from that living ſyſtem to which it belongs? If the heart be the moſt irritable muſcle of the body, if all this irritability ariſe from the nerves, how can it be that this muſcle, which is thus announced as the moſt dependent on its nerves, is really the moſt independent? that the muſcle which of all the body needs this nervous ſupply ofteneſt ſhould want it the leaſt, and ſhould ſurvive the loſs of its nerves ſo much longer than the other muſcles of the ſame body?

Although the ancients knew how irritable the heart was, although they often opened living creatures, and ſaw the heart ſtruggling to relieve itſelf, becauſe it was oppreſſed with blood, yet they continued entirely ignorant of the cauſe: and why the heart ſhould alternately contract and relax without ſtop or interruption, ſeemed to them the moſt inexplicable thing in nature. Hippocrates aſcribed it to the innate fire that is in the heart; Sylvius ſaid, that the old and alkaline blood in the heart mixing with the new and acid chyle, and with the pancreatic lymph, produced a ferment there; Swammerdam, Pitcairn, and Freind, thought that the heart, and every muſcle which had no antagoniſt muſcle, was moved by a leſs proportion of the vital ſpirit than other muſcles required. Others believed that each contraction of a muſcle compreſſed the nerves of that muſcle, and each relaxation relieved it; and that this alternate compreſſion and relief of the nerve was the cauſe of the alternate movements of the heart: another phyſician of our own country, a great mechanic and a profound ſcholar in mathematics, and all thoſe parts of ſcience which have nothing to do with the philoſophy of the human body, refined upon this theory moſt elegantly; for obſerving that the nerves of the heart turned round the aorta, and paſſed down betwixt it and the pulmonic artery, he explained the matter thus: "Theſe great arteries, every time they are full, will compreſs the nerves of the heart, and ſo ſtop this nervous fluid, and every time they are emptied (a thing which he choſe to take for granted, for in truth they never are emptied), they muſt leave the nerves free, and let the nervous fluid paſs down to move the heart."

Des Cartes, who ſtudied every thing like a right philoſopher of the old breed, viz. by conjecture alone, ſuppoſed that a ſmall quantity of blood remained in the ventricle after each ſtroke of the heart; which drop of blood fermented, became a ſort of leaven, and operated upon the next blood that came into the heart "like vitriol upon tartar;" ſo that every ſucceſſive drop of blood which fell into the ventricle ſwelled and puffed up ſo ſuddenly as to diſtend the heart, and then burſt out by the aorta. Philoſophers have been ſo bewitched with the deſire of explaining the phenomena of the human body, but without diligence enough to ſtudy its ſtructure, that from Ariſtotle to Buffon, it is all the ſame, great ignorance and great preſumption. But on this ſubject of the pulſe of the heart, phyſicians almoſt ſurpaſſed the philoſophers in the abſurdity of their theories, till at laſt they were reduced to the ſad dilemma of either giving up ſpeaking upon this favourite ſubject, or of contenting themſelves with ſaying, "that the heart beat by its facultas pulſifica, its pulſative faculty;" as if they had ſaid, the jaws chew by their mandicative faculty, and the bladder piſſes by its expulſive faculty, and the womb expels children by its parturient power.

The ancients, I have ſaid, often opened living creatures, and ſaw the heart ſtruggling to relieve itſelf becauſe it was oppreſſed with blood: this blood is itſelf the ſtimulus which moves the whole; for important as this function is, it is equally ſimple with all the others: and as urine is the ſtimulus to the bladder, food an excitement to the inteſtines, and the full grown fœtus a ſtimulus to the womb!—ſo is blood the true ſtimulus to the heart. When the blood ruſhes into the heart, the heart is excited and acts; when it has expelled that blood, it lies quieſcent for a time; when blood ruſhes in anew, it is rouſed again: ſo natural is both the inceſſant action and regular alternation of contraction and relaxation in the heart.

It is when we are ſo cruel as to open a living creature that we ſee beſt both the operation of the blood as a ſtimulus, and the manner in which the heart reacts upon it. When we tie the two vena cavas ſo as to prevent the blood from arriving at the heart, the heart ſtops; when we ſlacken our ligatures and let in the blood, it moves again; when we tie the aorta, the left ventricle being full of blood will continue ſtruggling, bending, turning up its apex, and contracting inceſſantly and ſtrongly, and will continue this ſtruggle long after the other parts have loſt their powers. One author, whether from his awkwardneſs or the delicacy of the ſubject, or really from the ſtrength of the ventricle, aſſures us, that often while he has held the aorta of a Frog cloſe with pincers, it has burſt by the mere force of the heart. If, after violent ſtruggles of this kind, you cut the aorta, even of ſo ſmall a creature as an Eel, it will throw its blood to the diſtance of three or four inches.

Thus we not only know that we can excite the heart by accumulating blood in it, but that by confining the blood in it we can carry that excitement to a very high degree; and in ſhort, by keeping the one or the other ventricle inceſſantly full of blood, we can make the one heart work continually, while the other lies quiet, or is only ſlightly drawn by the other's motion, ſhowing the true diſtinction betwixt the heart of the body and the heart of the lungs. And this is a memorable fact, that it is not merely the ſtimulus of the blood, but the ſenſe of fulneſs that makes the heart contract; for the auricle often beats twice or thrice, ſometimes it makes its puſh four or five times, before it can force the ventricle to contract.

When we empty the heart, and tie all its veins, all its parts ceaſe to act; ſtimuli applied outwardly make it contract partially; it trembles in particular fibres: but it is only letting in the blood, or blowing it up with air, that can bring it into full action again. When we look with cruel deliberation upon the ſtrokes of the heart in any living creature, we obſerve that at firſt, during the full and rapid action of the heart, there is hardly any perceptible interval among the ſeveral parts; but towards the end of each experiment, when the pulſe flags, and the creature falls low, the ſwelling of the great veins, and the ſucceſſive ſtrokes of auricle and ventricle, are diſtinctly told. The dilatation and contraction of each part is what we cannot obſerve, they are ſo quick; but theſe things we diſtinctly obſerve: The auricle contracts and dilates the ventricle; the ventricle contracts, ſubſides, and fills the aorta; the aorta turns and twiſts with the force of the blood driven into it, and by its own reaction, and the ventricle, every time that it contracts, aſſumes a form ſlightly curved, the point turning up like a tongue towards the baſis, and the baſis in ſome degree bending towards the point. The baſis, indeed, is in ſome degree fixed to the diaphragm and ſpine, but the heart in its contraction always moves upon its baſis as upon a centre; its ventricles, and eſpecially its apex, are free; the point riſes and curves ſo as to ſtrike againſt the ribs; and the dilatation of the heart is ſuch (together with the poſture and relation of its ſeveral parts), that during the dilatation the heart turns upon its axis one way; the contraction of the heart reverſes this, and makes it turn the other way, ſo that it ſeems to work perpetually with the turning motions of a ſcrew. All this is moſt ſtriking, while we are looking upon the motion of the heart in a living creature.

The poſture of the human heart is very ſingular, and will illuſtrate this turning motion extremely well; for in the human heart the poſture is ſo diſtorted, that no one part has that relation to another which we ſhould beforehand expect. In the general ſyſtem, the human heart is placed nearly in the centre, but not for thoſe reaſons which Dionis has aſſigned; it is not in order that by being in the centre it may feel leſs the difficulty of driving the blood to any particular limb or part of the body; it is the place of the lungs that regulates the poſture of the heart; and wherever they are, it is. Except the Oyſter, I hardly know of any creature in which the heart lies expreſsly in the centre of the body. In Frogs, Toads, Newts, and Snakes, the lungs are not moved by any diaphragm; they are filled only by the working of the jaws, the lungs then begin under the jaws, and the heart is lodged at the root of the jaws, leaving, as in a Newt or Cameleon, Crocodile, Adder, Serpent, &c. the whole length of their trailing body behind. In a fiſh, the gills ſerve the creature for lungs; the gills are lodged under the jaws, and the heart is placed betwixt them. In inſects, as in the common Caterpillar (the aurelia of our common Butterfly), the air enters by many pores on its ſides; and accordingly its heart is not a ſmall round bag, but may be eaſily ſeen running all down its back, working like a long aorta, but having regular pulſations, denoting it to be the heart; and this you eaſily ſee through the inſect's ſkin, for it is more tranſparent along the back where the heart is.

The breaſt in man is divided into two cavities by a membrane named the MEDIASTINUM. This membrane paſſes directly acroſs the breaſt from the ſternum before, till it fixes itſelf into the ſpine behind. It is on the left ſide of this membrane, in the left cavity of the breaſt, that the heart is placed, lying out flat upon the diaphragm as upon a floor, by which it is ſupported *; and that ſurface (*a*)—which lies thus upon the diaphragm, is perfectly flat, while the upper ſurface (*b*)—or what we uſually call the fore-part of the heart, is remarkably round. The whole heart lies out flat upon the diaphragm; its baſis (*c*)—where the auricles are, is turned towards the ſpine and towards the right ſide; the apex (*d*)—or acute point, is turned forwards, and a little obliquely towards the left ſide, where it ſtrikes the ribs; the vena cava (*e*)—enters in ſuch a manner through a tendinous ring of the diaphragm *, that it ties down the right auricle to that floor (as I may term it) of the thorax; the aorta (*f*) does not riſe in that towering faſhion in which it is ſeen when we take a dried-up heart, which naturally we hold by its apex, inſtead of laying it out flat upon the palm of our hand; nor in that perpendicular direction in which hitherto, for the ſake of diſtinctneſs, I have repreſented it in theſe plans; but the aorta goes out from its ventricle towards the right ſide of the thorax; it then turns in form of an arch, not directly upwards, but rather backwards towards the ſpine; then it makes a third twiſt to turn downwards; where it turns downwards it hooks round the pulmonic artery (*g*),—juſt as we hook the fore-fingers of our two hands within one another. The right heart (*hh*)—ſtands ſo before the other, that we ſee chiefly the right

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* The true poſition of the heart is what is repreſented in N° 16. and 17.; where N° 16. ſhows the heart ſet upright, as I have hitherto

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hitherto repreſented it in all my plans, while N° 17. repreſents its inclined poſition lying almoſt horizontally upon the floor of the diaphragm.

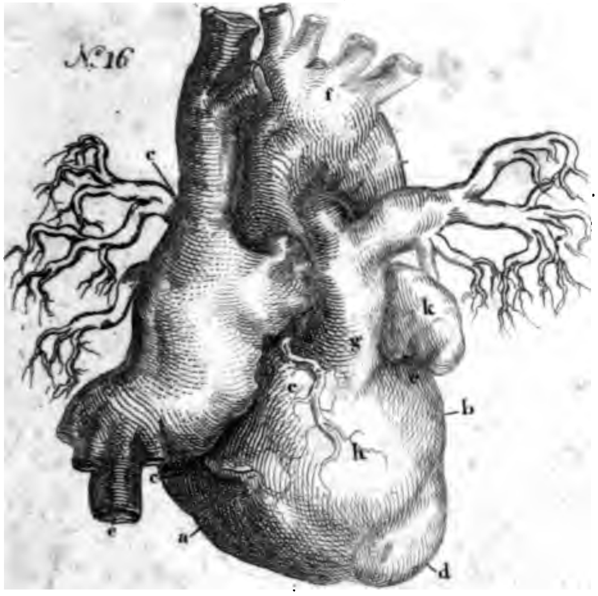
* Let it be obſerved, that (*e*) in this drawing marks the point where the lower cava was tied cloſe upon the diaphragm, to prevent the injection going down into the liver.

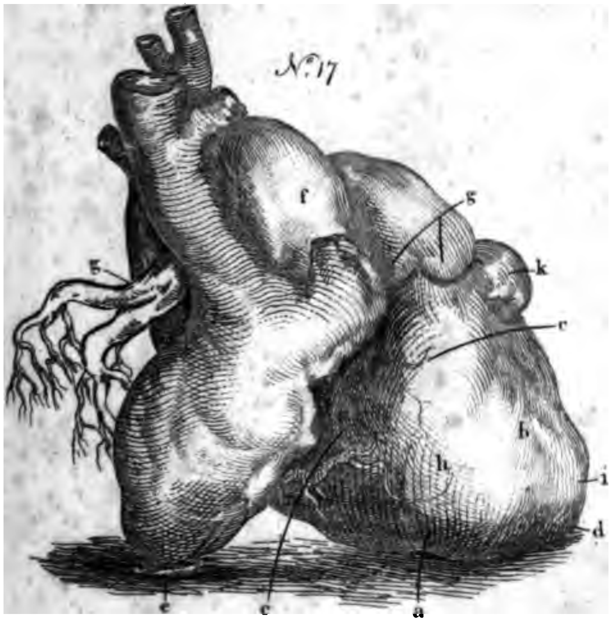
auricle

Sketches

P. 48

Demonstrating the true position of the Heart.


N.º 16


N.º 17

J. Bell sc.

auricle and ventricle before, ſo that it might be named the anterior heart; the pulmonic artery (*g*)—covers the root of the aorta; the left ventricle (*i*),—from which the aorta riſes, ſhows little more than its point at the apex of the heart; the left auricle (*k*)—is ſeen only in its very tip or extremity, where it lies juſt behind the pulmonic artery; and the aorta (*f*)—ariſes from the very centre of the heart. From this view any man may underſtand theſe veſſels by other marks than the mere colours of an injection; and he will alſo eaſily underſtand why the heart twiſts ſo in its actions, and how it comes to paſs that its poſture is difficult for us to conceive, no one part having that relation to any other part which we ſhould beforehand ſuppoſe.

Of the PERICARDIUM.

But the PERICARDIUM, purſe, or capſule, in which the heart is contained, affects and regulates its poſture, and makes the laſt important point concerning the anatomy of the heart. It is a bag of conſiderable ſize and great ſtrength, which ſeems to us to go very looſely round the heart, becauſe when we open the pericardium the heart is quite empty and relaxed; but I believe it to ſurround the heart ſo cloſely as to ſupport it in its palpitations, and more violent and irregular actions; for when we inject the heart, its pericardium remaining entire, that bag is filled ſo full that we can hardly lay it open with a probe and lancet without wounding the heart; and ſtill further, when we open the pericardium before we inject the heart, the heart receives much more injection, ſwells to an unnatural bulk for the thorax that it is contained in, and loſes its right ſhape. The pericardium is formed like the pleura and mediaſtinum, of the cellular ſubſtance; it is rough and irregular without, and fleecy with the threads of cellular ſubſtance, by which it is connected with all the ſurrounding parts; within it is ſmooth, white, tendinous, and gliſtening, and exceedingly ſtrong. As the heart lies upon the floor of the diaphragm, the pericardium, which lies under the heart, is connected with the diaphragm a little to the left of its tendinous centre, and ſo very ſtrongly that they are abſolutely inſeparable. The pericardium ſurrounds the whole heart, but it is looſe every where except at the root of the heart, where it is connected with the great veſſels: For the pericardium is not fixed into the heart itſelf, but riſes a conſiderable way upon the great veſſels, gives them an outward coat, and ſurrounds each veſſel with a ſort of ring, as may be ſeen in the plan *. For, 1ſt, It ſurrounds the pulmonic veins where they are entering the heart; there the pericardium is ſhort: 2dly, It mounts higher upon the vena cava than upon any other veſſel; the cava of courſe is longer within the pericardium, and it alſo is ſurrounded with a ſort of ring: 3dly, It then paſſes round the aorta and pulmonic artery, ſurrounding theſe in one greater loop: 4thly, The cava inferior is the veſſel which is the ſhorteſt within the pericardium: for the heart inclines towards the horizontal direction; it lies in a manner flat upon the upper ſurface of the diaphragm, while the lower ſurface of the diaphragm adheres to the upper ſurface of the liver. Thus it happens that the liver and the right auricle of the heart are almoſt

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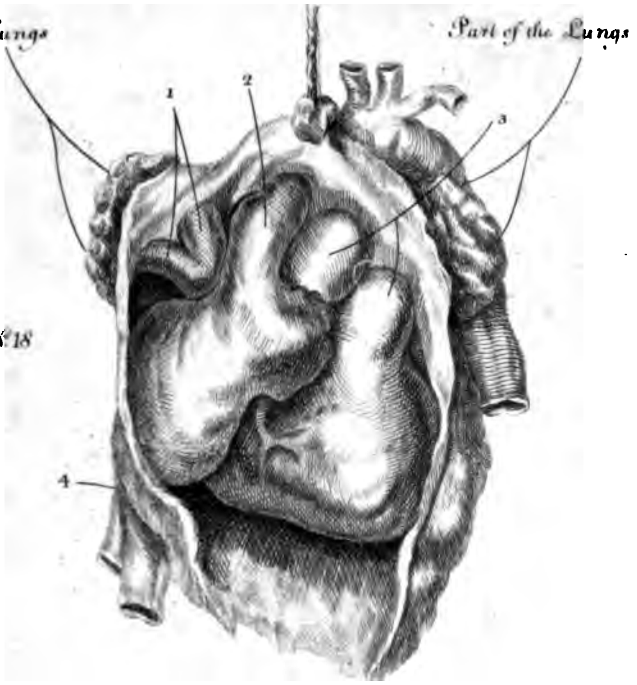
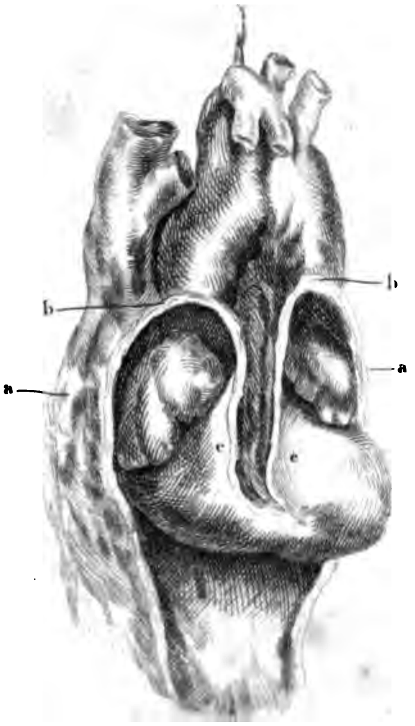
* Vide Plan, N° 18.

o Sketches
the Pericardium of which N° 18 is a true drawing N° 19 a Plan
shewing its inflexion over the Heart



N° 18



N° 19

in contact, the diaphragm only intervening; thence the lower cava which paſſes from the liver into the right auricle of the heart cannot have any length. While the pericardium thus paſſes round the great veſſels, it muſt leave tucks and corners; and theſe have been named the CORNUA or horns of the pericardium.

But there is another peculiarity in the form of the pericardium, which I have explained in this ſecond plan*; viz. that the pericardium conſtitutes alſo the immediate coat of the heart; for the pericardium having gone up beyond the baſis of the heart ſo as to ſurround the great veſſels, it deſcends again along the ſame veſſels, and from the veſſels goes over the heart itſelf. I have marked the manner of this more delicate inflection of the pericardium at (*aa*),—where the pericardium is looſe; at (*bb*),—the angle where it is reflected; and at (*cc*),—where it forms the outer coat of the heart. The pericardium where it forms this outer coat becomes extremely thin and delicate, almoſt cuticular, but ſtrong: under this coat there is much cellular ſubſtance; the coronary arteries paſs along in this cellular ſubſtance, the muſcular fibres are bound together by it, and under it the fat is gathered ſometimes in a wonderful degree, ſo as to leave very little to be ſeen of the dark or muſcular colour of the heart.

The pericardium then is a denſe and very ſtrong membrane, which I would compare with the capſule of any great joint, both in office and in form: for it is rough and cellular without, ſhining and tendinous within; bedewed with a ſort of halitus like the great joints, delicate and almoſt a cobweb-like membrane in the child, but increaſing in thickneſs by the continual frictions of the heart, juſt as a capſular ligament does by the working of its joint; and its uſes are to keep the heart eaſy and lubricated by that exhalation which proceeds from its exhalent arteries (and not from any glands), and which can be imitated ſo eaſily by injecting tepid water into its arteries, to ſuſpend the heart in ſome degree by its connections with other parts, eſpecially by its connections with the mediaſtinum and diaphragm; and to limit the diſtentions of the heart, and check its too violent actions, juſt as we ſee it prevent too much of our injections from entering the heart. How ſtrong the pericardium is, and how capable of ſupporting the action of the heart, even after the moſt terrible accidents, we know from this; that the heart or coronary arteries have actually burſt, but with a hole ſo ſmall as not to occaſion immediate loſs of life; then the pericardium receiving the blood which came from the rupture, has dilated in ſuch a manner as to receive nine or ten pounds of blood, but has yielded ſo ſlowly as to ſupport the heart in ſome kind of action, and ſo preſerved life for two or three days.

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* N 19.

If I have not mentioned any fluid under the direct name of AQUA PERICARDII, or the water of the pericardium, it is becauſe I conſider the accident of water being found as belonging not to the healthy ſtructure but to diſeaſe. Yet this ſame water occupied the attention of the older authors in a moſt ludicrous degree. Hippocrates believed that this water of the pericardium came chiefly from the drink we ſwallow, which found ſome way or other (as it paſſed by the pericardium) to inſinuate itſelf into this bag:

Some after him ſaid, it was the fat of the heart melted down by inceſſant motion and the heat of the heart; ſome ſaid it was from humours exuding through the heart itſelf, and retained by the denſity of the pericardium that this water came; and it is but a few years ſince this clear and diſtinct account of it was given, viz. "that it proceeds from the aqueous excrementitious humour of the third concoction." The ſame "ſad and learned men *, viri graves et docti," declare to us, that the uſes of the aqua pericardii are to cool the heart, for it is the very hotteſt thing in the body; or by its acrimony to irritate the heart, and ſupport its motions; or to make the heart by ſwimming in it ſeem lighter. By this it is pretty obvious what abſurd notions they had of the quantity of water that may be found in the heart. But of all the outrages againſt common ſenſe and common decorum, the moſt ſingular was the diſpute maintained among them, whether it was or was not the water of the pericardium which ruſhed out when our Saviour's ſide was pierced with the ſpear? The celebrated Bardius, in a learned letter to Bartholine, ſhows how it was the water of the pericardium that flowed out; but Bartholine, in his replication thereunto, demonſtrates, that it muſt have been the water of the pleura alone. This abominable and ludicrous queſtion, I ſay, they bandied about like boys rather than men: Bartholinus, Arius Montanus, Bertinus Nicelius, Fardovius, Laurenbergius, Chiprianus, with numberleſs other Doctors and

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* They are thus denominated in all the charters of the College of Phyſicians from the time of Henry VIII. downwards.

Saints, were all buſy in the diſpute; for which they muſt have been burnt, every ſoul of them, at the ſtake, had they done this in ridicule; but they proceeded in this matter with the moſt ſerious intentions in the world, and with the utmoſt gravity *. The whole truth concerning water in the pericardium is, that you find water there whenever at any time you find it in any of the other cavities of the body. If a perſon have laboured under a continued weakneſs, or have been long diſeaſed, if a perſon have lain long on his death-bed, if the body have been long kept after death, there is both a condenſation of the natural halitus in all the parts of the body, and an exudation of thin lymph from every veſſel; there is water found in every cavity, from the ventricles of the brain to the cavity of the ankle joint, and ſo in the pericardium among the reſt. But if you open any living animal as a Dog, or if you open ſuddenly the body of a ſuicide, or a criminal who has been juſt hanged, not a drop of

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* The ſhocking indecencies of their reaſonings on this ſubject I will not condeſcend to draw out from the obſcurity of that barbarous idiom in which was delivered: " Sed non cogar huc me conferre. Fateor enim nativam Chriſti temperiem nihil pravorum humorum produxiſſe, quia perfectiſſima; at a cauſis externis, vigiliis, cruciatibus, itineribus, vulneribus et mille tormentis quid non præter conſuetam naturæ divinæ perfectionem productum credimus? Ad hæc ſano ſenſu id accipiendum, nihil pravorum humorum in corpore Chriſti generatum." *Bartholini Epiſtolæ*, p. 299.—" Idque de Salvatore innoxie dixeris, quem ſcimus manducaſſe, bibiſſe, dormiviſſe, ambulaſſe et quid non egiſſe, ut ſe hominum cunctis actionibus, quæ ſecundum naturam ſunt, ſubmitteret: ſputum emiſit, quum luto miſceret ad curandum cæcum, et ſudavit ingruente martyrio, et ſine dubio non parum ſeri in thorace collegit, quod, aperto poſt mortem latere, emanavit." *Bartholini Epiſtolæ*, p. 300.

water will be found in the pericardium. When ſuch fluid is to be found, it is of the ſame nature with the dropſical fluids of other cavities: in the child, and in young people, it is reddiſh, eſpecially if the pericardium be inflamed; in older people it is pellucid, or of a light ſtraw colour; in old age and in the larger animals it is thicker, and more directly reſembles the liquor of a joint.

Thus does the pericardium contribute in ſome degree to ſettle the poſture of the heart; but ſtill the heart is almoſt entirely looſe and free. It is fixed by nothing but its great veſſels as they run up towards the neck, or are connected with the ſpine; but how ſlight this hold is, how much the heart muſt be moved, and theſe veſſels endangered, by ſhocks and falls, it is awful to think. The pericardium is no doubt ſome reſtraint: its connections with the diaphragm and with the mediaſtinum make it a proviſion, in ſome degree, againſt any violent ſhock; its internal lubricity is, at the ſame time, a means of making the heart's motions more free: yet the heart rolls about in the thorax; we turn to our left ſide in bed, and it beats there; we turn over to our right ſide, and the heart falls back into the cheſt, ſo that its pulſe is nowhere to be perceived; we incline to our left ſide again, and it beats quick and ſtrong. The heart is raiſed by a full ſtomach, and is puſhed upwards in dropſy; and during pregnancy its poſture is remarkably changed; it is ſuddenly depreſſed again when the child is delivered, or the waters of a dropſy drawn off. It is ſhaken by coughing, laughing, ſneezing, and every violent efſort of the thorax. By matter collected within the thorax it may be diſplaced to any degree. Dr. Farquharſon cured a fine boy, about eight years old, of a great collection of matter in the cheſt, whoſe heart was ſo diſplaced by a vaſt quantity (no leſs than four pounds) of pus, that it beat ſtrongly on the right ſide of the breaſt while his diſeaſe continued, and as ſoon as the pus was evacuated, the beating of the heart returned naturally to the left ſide. Who could have believed that, without material injury, the heart could be ſo long and ſo violently diſplaced? Felix Platerus tells us a thing not ſo eaſily believed, that a young boy, the ſon of a printer, having practiſed too much that trick which boys have of going upon their hands with their head to the ground, began to feel terrible palpitations in the left breaſt; theſe gradually increaſed till he fell into a dropſy from weakneſs, and died; and upon diſſecting his body, the ſituation of his heart was found to have been remarkably changed by this irregular poſture. Now we are not to argue that ſuch change of poſture of the heart could not happen merely from this cauſe, becauſe profeſſed tumblers have not theſe diſeaſes of the heart; it were as ſilly to argue thus againſt the authority of Platerus, as to ſay that every poſt-boy has not aneuriſms of the ham, or that every chimney-ſweep has not a cancer of the ſcrotum.

We may now cloſe this chapter on the mechaniſm of the heart, in which all the parts have been ſucceſſively explained. We know how the heart is ſuſpended by the mediaſtinum and by its great veſſels; how it is lubricated, ſupported, and regulated in its motions, by the pericardium; its nerves, which remain to be explained at a fitter time, are extremely ſmall, while its vis inſita, or irritability, is great beyond that of all the other parts. We can eaſily follow the circle of the blood, which, as it arrives from all the extremities irritates the auricle, is driven down into the ventricle, is forced thence into the pulmonic artery, pervades the lungs, and then comes round to the left ſide of the heart, or to that heart which ſupplies the body; and there begins a new circulation, called the greater circulation, viz. of the body, as the other is called the leſſer circulation of the lungs. Thus we recogniſe diſtinctly the functions of the double heart, with all its mechaniſm; the ſtronger heart to ſerve the body, the weaker heart to ſerve the lungs; and we ſee in the plaineſt manner two diſtinct functions performed by one compound heart: the right heart circulates the blood in the lungs, where it is purified and renewed; the left delivers out a quantity of blood, not ſuch as to fill all the veſſels, nor ſuch as to move onwards by this ſingle ſtroke of the heart to the very extremities of the body, but ſuch merely as to give a ſenſe of fulneſs and tenſion to the veſſels: the force is merely ſuch as to excite and ſupport that action which the arteries every where perform in the various organs of the body, each artery for its appropriated purpoſes, and each in its peculiar degree.

By underſtanding thus the true mechaniſm and uſes of the heart, we can conceive how the ancients were led into ſtrange miſtakes, by very ſimple and natural appearances. We underſtand why Galen called the right auricle the "ultimum moriens," or the part which died laſt; for, upon opening the body ſoon after death, he found the right auricle filled with blood, and ſtill palpitating with the remains of life, when all the other parts ſeemed abſolutely dead; and if the blood always accumulates in the right ſide of the heart before death, it is plain that the ſtimulus of that blood will preſerve the remains of life in the right ſide, after all appearance of life on the left ſide is gone. But the cauſe of this accumulation of blood in the right ſide is very ill explained by Haller, though it ſeems to have employed his thoughts during half his life. He ſays, that in our laſt moments we breathe with difficulty; the lungs at laſt collapſe, and ceaſe to act; and when they are collapſed, no blood can paſs through them, but muſt accumulate in the right ſide of the heart. That there is really no ſuch collapſe of the lungs, I propoſe hereafter to ſhow; but, in the meanwhile, this is the true reaſon, viz. that when the ventricles of the heart ceaſe to act, and the beating of the heart ſubſides, the two auricles lie equally quiet, but in very different conditions; the right auricle has behind it all the blood of the body pouring in from all parts during the laſt ſtruggles; but the left auricle has behind it nothing but the empty veins of the lungs; nothing can fill it but what fills the veſſels of the lungs; or, in other terms, nothing can fill the left auricle but the ſtroke of the heart itſelf; but inſtead of acting, the heart falls into a quieſcent ſtate, the left auricle remains empty, while the blood oozes into the right auricle from all the extremities of the body till it fills it up.

Nothing is more agreeable than to find ſuch phenomena deſcribed faithfully long before the reaſon of them is underſtood. In the Pariſian diſſections I find the following deſcription: "When the breaſt of a living Dog is opened by taking away the ſternum, with the cartilaginous appendices of the ribs, the lungs are obſerved ſuddenly to ſink, and afterwards the circulation of the blood and the motion of the heart to ceaſe. In a little time after that the right ventricle of the heart and the vena cava are ſwelled, as if they were ready to burſt."* This was what deceived the ancients, and was the cauſe of all their miſtakes. When they found the right ventricle thus full of blood, they conceived that it alone conveyed the blood; they found the left ventricle empty, and believed that it contained nothing but vital ſpirits and air: and ſo far were they from having any notions of a circulation, that they thought the air and vital ſpirits went continually forwards in the arteries; that the groſs blood which was prepared in the liver came up to the heart to be perfected, and went continually forwards in the veins, or, if they provided any way of return for theſe two fluids, it was by ſuppoſing that the blood and ſpirits moved forwards during the day-time, and backwards in the ſame veſſels during the night.

Theſe things next explain to us why they called the right ventricle VENTRICULUS SANGUINEUS: they found it full of blood, and thought its walls were thinner, becauſe it had only to contain the very groſſeſt parts of the blood: and why they called the left ventricle VENTRICULUS SPIRITUOSUS and NOBILIS, becauſe they ſaw it empty, and concluded that it contained the animal ſpirits and aërial parts of the blood, and its walls were thicker, they ſaid, to contain theſe ſubtile ſpirits. They explain to us their names of ARTERIA VENOSA and VENA ARTERIOSA; for they would have veins only on the right ſide of the heart, and arteries only on the left; and although they ſaw plainly that the pulmonic artery was an artery, they called it Arteria Venoſa; and although, on the left ſide again, they ſaw plainly that the pulmonic vein was merely a vein, they would ſtill cheat themſelves with a name, and call it Vena Arterioſa: the veins, they ſaid, were quiet, becauſe they contained nothing but mere blood; the arteries leaped, they ſaid, becauſe they were full of the animal ſpirits and vital air.

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* Page 261.

The very name and diſtinction of arteries which we now uſe, ariſe from this fooliſh doctrine about air and animal ſpirits. To the oldeſt phyſicians there was no veſſel known by the name of artery, except the ASPERA ARTERIA; and it was named Artery becauſe it contained air; ſo that Hippocrates, when he ſpeaks of the carotids, never names them arteries, but calls them the Leaping Veins of the neck. But when Eriſtratus had eſtabliſhed his doctrine about the veſſels which go out from the heart, carrying vital ſpirits and air, the name of artery was transferred to them; and then it was that the ancients began to call the veſſels going out from the left ſide of the heart arteries, naming the aorta the ARTERIA MAGNA and the pulmonic vein the ARTERIA VENOSA.

When a vein was cut, they ſaw nothing but groſs blood, and of a darker colour; but when an artery was cut, they obſerved that the blood was red; that it was full of air bubbles; that it ſpurted out, and was full of animal ſpirits; and thus it became eaſy for them to ſhow how ſafe it was to open a vein where nothing was loſt but groſs blood, how terribly dangerous it was to open an artery which was beating with the ſpirit of life; and this they conſidered as ſuch an awful difference, that when arteriotomy in the temple was firſt propoſed, they pronounced it murderous, and on this reaſoning it was abſolutely forſaken for many ages.

But the oldeſt of our modern phyſicians ſoon found a neceſſity of mixing this blood and animal ſpirits together, and for a long while could hit on no convenient way by which this mixture might be effected: as a laſt ſhift, they made the blood exude through the ſeptum of the heart; and then the current doctrine was, that of the blood which came from the liver, one half went into the pulmonic artery to nouriſh the lungs; the other half exuded through the ſeptum of the heart to mix with the animal ſpirits. Riolanus was the bitter enemy of Harvey and of his noble doctrine; and this is the miſerable and confuſed notion, not to call it a doctrine, which he trumpeted through Europe in letters and pamphlets. To make good this miſerable hypotheſis, Riolanus, Gaſſendus, and many others, ſaw the neceſſity of having ſide paſſages through the ſeptum of the heart. I really believe from their mean equivocating manner of talking about theſe paſſages, that they had never believed them themſelves *. "The chyme," ſays Bartholine, "and the thinner blood, paſſes through the ſeptum of the heart, when the heart is in ſyſtole and the pores and paſſages are enlarged." Thus did the celebrated Bartholine believe the ſeptum perforated. Wallæus, and Marchetti, and Mollinettus, and Monichen, believed it, and Mr. Broadbecquius of Tubingen proved it †. But I believe moſt potently with Haller, that whenever they wanted to ſhow thoſe perforations, they managed their probes ſo as to make paſſages as wide and as frequent as the occaſion required: "Solebant foramina parare adigendo ſtylos argenteos in reſiſtens ſeptum," ſays Haller; and this is a full and true account of all the authors who have deſcribed ſide paſſages through the ſeptum of the heart: they needed them, and they made them.

Amidſt all this ignorance, we cannot wonder that a thouſand childiſh imaginations prevailed, nor that the qualities of the mind were deduced from the phyſical properties of the heart. We have heard the vulgar, for example, ſpeak of the bone of the heart. And from whom did this ariſe? From Ariſtotle! who explains to us, that there is at the root of the heart a bone which ſerves for its baſis; and not a phyſician has written upon the heart ſince his time, who has not ſpoken more or leſs myſteriouſly about this bone;

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[*] That I may not ſeem to ſpeak too harſhly of this knot of conſpirators againſt Harvey, I will quote what Boerhaave ſays of Riolanus, who was at the head of them: "Non ipſe callidus cavillationum artifex Riolanus," &c.

[†] Experimento perforatum oſtendit Broadbecquius Tubingæ.

while in truth the whole ſtory means nothing more than this, that where the baſis of the arteries are fixed into the hard ring or baſis of the heart, the place is extremely firm, almoſt cartilaginous, eſpecially in old age, when often the roots of the arteries are oſſified, or converted into what anatomiſts have choſen to call bone.

Often alſo we have heard the vulgar talk, not figuratively, but in the plain ſenſe of the words, of a little or big heart, as ſynonymous with a timorous or courageous heart. But whenever we hear miſtakes of this kind among the vulgar, we may be aſſured they have ſome time or other come from high authority. Bartholine was ſo much convinced that a ſmall heart begot courage, and a great one irreſolution and fear, that he is thoroughly ſurpriſed when he finds the contrary; "Cor vaſtus fuit homo, tamen audax fuerat, ut cicatrices in capite frequentes et rimæ in cranio teſtabantur." But if Bartholine be right, Kirkringius is quite wrong, and has miſtaken the doctrine; for he ſays, "An magnanima fuerit hæc magni cordis fœmina, neſcio," &c. "I do not know whether this woman's courage was as big as her heart; but this I do know, that ſhe was a famous topper. Whether this drinking dilates the heart, and makes your ſtaunch drinkers ſuch famous fighters, I cannot pretend to decide." We have heard the vulgar talk alſo of a hairy heart, as familiarly as of a hairy man, being the mark of high courage and ſtrength; but what ſhall we think of it, when we find that this report is to be deduced fairly from Pliny, through the moſt celebrated names among our old phyſicians? He it was who began

gan with telling how the Meſſenians, that unhappy people who lived for ſo many ages the ſlaves or helots of Greece, loſt their great general Ariſtomenes. But how great he was, never, according to Pliny, came to be known till after his death; for the Lacedemonians having catched him three times, reſolved at laſt to open his breaſt; and there, as a proof of his moſt invincible courage and daring, they found his heart filled with hair. This from Pliny were nothing, if ſuch diſſections had not been made ſince then a hundred times. "There was a robber (ſays Benivinius), one Jacobus, who having been taken down from the gibbet apparently dead, but really having in him the remains of life, was laid carefully, recovered, was perfectly reſtored, betook himſelf to his old ways again; and ſo in the natural courſe of things came round to his old mark the gallows, and was this time very thoroughly hanged. Wondering (ſays Benivinius) at the perfect wickedneſs of this man, I longed very anxiouſly to diſſect the body, and I actually found the heart, not covered, but (refertum pilis) crammed with hair."

But there is, in fact, no end of wonders and wonderful diſſections among theſe robbers of his. His next ſubject was not a bold robber, but a poor ſneaking thief (de corde furis cujuſdam); there was no hair to be expected in his heart; but as he was a thief only, it was conſiſtent with this doctrine that he ſhould be firſt very heartleſs; ſecondly, have very little brain; thirdly, that he ſhould have very inordinate appetites and deſires. Now there was firſt a great two-legged vein carrying the atrabilis, the ſource, no doubt, of all his inordinate cravings, directly into the ſtomach. Secondly, there was a great abſceſs full of pus waſting the left ſide of his heart; and, thirdly and laſtly, the back part of the head, (which all the anatomiſts of that time knew very well was the ſeat of memory) was in him ſo ſmall that it could hardly contain a ſpoonful of that kind of brain; and this want was the reaſon (having ſo little memory) that he was ſo perſevering a thief; for let you whip him, baniſh him, clap him in the ſtocks, he forgot it ſtraightway, and was back at his old tricks again, like a dog to his vomit *."

But theſe are now almoſt forgotten, though perhaps the hiſtory of the abſurdities of the human genius ſhould no more be neglected than of its beauties. Is it not delightful to feel, that after floating in this ocean of conjecture, after all theſe diſorderly and wild dreams, we are come to have an idea of the heart, ſimple and beautiful; of a heart containing within itſelf two functions; firſt, the office of renewing the blood; ſecondly, the office of animating the arteries, and by them preſerving in life and action the whole ſyſtem of the body? Theſe are the two offices which I ſhall now proceed to explain.

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* "Non videntur ſilentio eſſe prætereunda, quæ nuper in inciſo Jacobi cujuſdam furis inſignis cadavere annotavimus: bifurcatam ſcilicet venam quæ a liene ad ventriculum atram defert bilem, tum et abſceſſum in ſiniſtro cordis ventre pituita redundantem: poſtremo et poſteriorem ejus capitis partem, ubi memoriæ ſedes eſt, adeo brevem, ut tantillam cerebri portiunculam contineret. Quam ob cauſam, cum priorum ſcelerum et eorum quæ pro his ſæpe paſſus fuerat, tormenta ſcilicet, exilia et carceres

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CHAP. II.

ON THE APPEARANCE AND PROPERTIES OF THE BLOOD, ON THE CHEMISTRY OF OUR FLUIDS, AND ON THE INFLUENCE WHICH AIR HAS UPON THEM.

BY the ſimpleſt methods the blood can be reſolved into various parts, but chiefly into theſe three; the red globules, which give colour to the blood; the gluten, which gives conſiſtency and nutritious qualities to the blood; and the ſerum, which dilutes, mixes, and ſuſpends the whole.

Though the ſerum and gluten did not paſs entirely unnoticed, the red globules were the part of the blood which firſt excited the attention of phyſicians, and ſeemed to promiſe a rich harveſt of diſcoveries; a promiſe which too ſurely never was fulfilled. The red particles have always appeared important, becauſe they ſeem to give the colour, the uſeful qualities, and the whole character to the blood. It is by the rolling of the red particles only that we ſee the circulation in the microſcope; it is red blood only that we ever name as blood; and the colour of the red blood changes in health and diſeaſe. But when phyſicians ſtudied this

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ceres minime recordaretur, toties ad vomitum tanquam canis impudens reverſus eſt, ut in laqueum tandem inciderit, vitæque ac furti finem fecerit."—Vid. *Benevinius.*

part alone, when they gave it the mark of chief importance, and annexed to it alone the name of blood, they little thought how far they over-rated its importance, how far the red particles are from nouriſhing the ſyſtem, from being eſſential to the blood, from being univerſal in all creatures. They had not conſidered what myriads of animals, great as well as ſmall, want the red particles, and (if theſe red particles are to be the characteriſtic) want blood; while philoſophers of leſs contracted notions have continued to call that fluid, blood, which fills the veſſels of plants.

The Harveian doctrine had no ſooner produced a revolution in the general doctrines of phyſiology, or phyſicians begun to think of the heart and its circulation, of the great arteries, and extreme veſſels, of the difference betwixt arteries and veins, and of the ways in which the fluids move through the ſmaller tubes, (for they ſaw them moving by their microſcopes); no ſooner did all theſe phenomena and new wonders preſent themſelves to their imaginations, than they thought alſo of curious ways by which theſe motions and ſecretions might be explained. They then began to eſtimate the calibres of the arteries, to calculate with great affectation of care the ſhape, the ſize, the compoſition, as they choſe to call it, of the particles of the blood; chimeras and fancies ſprung up innumerable; and it happened unfortunately that for a long while phyſicians ſtudied nothing but angles, and logarithms, and algebraical equations; they reaſoned according to thoſe ſciences only which have no connection with the phyſiology of the animal body; they calculated the force, the thickneſs, the dimenſions of the heart;

heart; the diameter, and the ſtrength of walls, and the direction of the aorta; their experiments conſiſted in fixing clumſy tubes into the arteries, or in calculating the whole quantity of blood by bleeding an animal to death; they applied nothing but the laws of hydraulics, *i. e.* of fluids riſing and falling in rigid tubes, to explain the active arteries of a living body: in ſhort, in explaining the living body they forgot that it was alive. But now the age of infallible proofs and demonſtrations has paſſed over, and the works of Keill, Pitcairn, Borelli, are quite neglected.

This diſordered and miſerable ſtate of ſcience, which continued for a century nearly, aroſe from thoſe red particles of the blood engroſſing too much attention, and from their being allowed an importance which does not belong to them; although one muſt ſtill acknowledge that they are very ſurpriſing, becauſe they are very unaccountable, at leaſt I do not know that any natural or likely uſe for them has been yet aſſigned.

Leeuwenhoek, looking through his glaſſes, ſaw that this which gave the red colour was the moſt permanent characteriſtic part of the blood; he ſaw that this part conſiſted of red particles floating in the ſerum; he found, or pretended to find, that they were of the ſame ſize in a Man as in a fœtus; in a Chick as in a Hen; in a Whale or Elephant, he found them the ſame as in a Mouſe or Minnow; merely becauſe it was convenient for him to find it ſo.

But poring ſtill longer over theſe particles, he perceived that the great globules were ſo far imperfect as often to break in pieces, and roll about in the ſerum in ſeparate parts; and he always found that there were ſix leſs parts compoſing the greater globule of the blood. By looking more and more, he pretended to obſerve, that theſe ſmaller parts into which the red globules broke down ſtill preſerved their form; that theſe were the particles of the ſerous part of the blood; and that the great or red particles frequently broke down into ſerous particles, and theſe again as frequently united and compoſed afreſh a red globule. He pretended to find, that exactly ſix ſmaller globules went to make up one great one; and he called the red and ſerous globules the globules of the firſt and ſecond order.

By this notion of orders it was plain that he intended to plunge deeper into this hypotheſis, and to have at leaſt a third and fourth order; beſides, theſe orders and particles were at his call, he might do as he pleaſed; and he was almoſt the only perſon poſſeſſed of glaſſes which could enable the phyſiologiſt to ſee and tell about them. He pored till he believed, or at leaſt made others believe, that he ſaw globules of a third order, ſix times ſmaller than the ſerous globules, and of courſe thirty-ſix times ſmaller than the red globules. And thus he had lymphatic particles, ſix of which made up one ſerous particle; and ſerous particles, ſix of which made one red globule.

To the geometrical phyſiologiſts of that day all this inſtruction concerning the ſtructure of the blood was moſt delightful; it correſponded very notably with their calculations about regularly deſcending ſeries of veſſels; and a moſt curious method did they find out for ſettling this law of the branching of arteries. They took the plates of Euſtachius, meaſured with compaſſes the arteries and veins, eſtimated the angles at which each branch goes off, compared the ſeveral branches with the parent trunk; and from ſuch calculations they ſettled the general law as heartily and freely, as if, inſtead of the moſt extravagant plates in all anatomy, they had been meaſuring actually the human body itſelf. Thus they had ſet up their doctrine of angles, branches, anaſtomoſes, trunks, and extreme veſſels: they had found that there was a regular ſeries of deſcending arteries; they had a tube now ſuited to every deſcending particle that Leeuwenhoek could invent; and when a particle had got into a wrong veſſel, it could go back till it found a tube that ſuited it; or if driven into a wrong bore, it could break itſelf down into ſerous or lymphatic particles. But when many particles did ſtick hard in the ſtrait places, then there was an error loci; then the big particles were out of their peculiar veſſels, and then the part began to be red; thence came inflammations, fevers, deeper obſtructions; and from ſuch cauſes, or from the breaking down of the blood and humours, came every diſeaſe that could be named.

So very greatly were they delighted with the diſcovery, that Dr. Martin, who had meaſured the veſſels, as I have juſt told, and had dreamt over this the longeſt and ſoundeſt of them all, ſpeaks of it in theſe rapturous terms. "But we are moreover certain from the obſervations of that moſt accurate and curious obſerver of the minima naturæ, that there are innumerable veſſels of ſuch a ſmallneſs that none of theſe globules could paſs; ſo that it is neceſſary to ſuppoſe inferior claſſes of globules of the fourth, fifth, ſixth, and other orders.—Whence by analogy we are to conceive globules of the third order made up of ſix globules of the fourth order, and theſe of ſix of the fifth order, and ſo on ad infinitum through various degrees, the number of which we are not to take upon us to determine." This is a pleaſant addition of Dr. Martin's; and makes it a moſt manageable ſyſtem of moſt dilatable materials, ſtretching ſo as to ſuit all occaſions. This rider or codicil to the doctrine made it eaſy for every particle to paſs every veſſel; but, alas! it leaves no room for that old catchword of the ſyſtem, the error loci, nor any proviſion for making diſeaſes.

How all the phyſicians in Europe could digeſt this abſurdity, of yellow particles, by aggregation and arrangements in ſixes and ſixes, becoming red, it is not eaſy to conceive; nor is it eaſy to conceive how men, whoſe education in mathematics and algebra ſhould have taught them to think accurately and reaſon cloſely, could believe that globules ſhould break down into ſix particles each, and that theſe particles, being themſelves particles of ſerum, ſhould yet be diſtinctly ſeen floating in the ſerum. How could theſe geometrical phyſicians poſſibly believe, that theſe particles, from large to ſmall, ſhould deſcend, not gradually and imperceptibly, but by ſixes and ſixes, one after another like ſteps of ſtairs? In all his mathematics, I do not believe that Martin could find any contrivance fit to help him out of theſe difficulties. Martin obſerves, in his own way of geometry, and proceeds to prove it by moſt laborious ſchemes, " that juſt ſix ſmall ſphericles ſhould go to make up one larger globule, if you were to chooſe the moſt convenient and firmeſt way of conſtructing it;" and then he wonders at Leeuwenhoek finding it exactly ſo. But if Leeuwenhoek knew this as well as Dr. Martin, I cannot for my heart think it any wonder that Leeuwenhoek choſe "the moſt convenient and firmeſt way of conſtructing a red globule, viz. out of ſix ſmaller ones." Seeing that he had the affair entirely in his own hands, "what a beautiful HARMONY and REGULARITY do we perceive, ſays Martin, in the maſs of blood? Magnum certe opus oculis video." In plain truth, they deſired but a little of this harmony, a little conſiſtency in their doctrine, and all was well.

But the miſtakes concerning the formation or organizing of this blood are worſe than theſe; for they came from men truly learned, and diligent in anatomy, led on by too ſtrong a deſire of finding out the uſes of ſeveral parts of the human body, as of the Spleen and Thymus, parts hitherto unexplained. Mr. Hewſon ſuppoſed that the lymphatic glands, which ſeem at firſt to be mere convoluted veſſels, but which microſcopes ſhow as conſiſting of numerous cells, form in theſe cells the primordia of the red blood; for each red particle he ſuppoſes to conſiſt of a central particle, which is ſolid and dark-coloured, ſurrounded by a veſicle which is tranſparent or white; and this dark or central part he ſuppoſes is formed in the lymphatic cells; for he finds a ſort of round particles in the lymph, and often he finds the lymphatics full of red blood.

Next, he has ſuppoſed that in the child there is required a much greater ſupply of blood; for this purpoſe is the thymus appointed; viz. to aſſiſt the lymphatic glands in organizing blood. This gland lies in the upper part of the cheſt, is great in the child, has vaniſhed in the adult, but while it exiſts, he finds it full of a milky juice or whitiſh mucus, fit to make central particles for the blood; and the lymphatics, as he ſuppoſes, are the excretories for this gland. He next conjectures, that this work, begun thus by the lymphatic glands, and thymus, is perfected by the ſpleen; that the lymphatics make central particles only, while the veſicular coverings are formed in the ſpleen; ſo that there only do the particles become perfect; and accordingly of theſe parts it is in the ſpleen alone that the red blood is found.

As the central particles are formed in the cells of the lymphatic glands, the veſicular parts are formed in the cells of the ſpleen, and the lymphatics unload theſe cells of the particles when completely formed: but there appears no other proof that they do this office than that there are cells in the ſpleen which may make veſicles; and that the lymphatics being tied, and the ſpleen ſqueezed, red globules are ſometimes found in them.

Long poring over a weariſome ſubject, and an intenſe deſire to finiſh that account of the blood which he had ſo ſucceſsfully begun, are ſtrong apologies for all theſe miſtakes. No man will venture to deny, that the glands and lymphatic veſſels probably accompliſh ſome important changes upon all fluids which paſs through them; but that they alone organize the blood, is not to be conceived. Their containing round white particles, argues nothing; theſe exiſt in the chyle, and probably in that condition paſs into the blood. But if the fœtus requires a great ſupply of blood, and the thymus aſſiſts the lymphatic glands, how comes it, when both lymphatic glands and thymus are working in concert to prepare a great quantity of blood, that the ſpleen, which is to finiſh all theſe particles, and to make veſicles for them, is not in a child as big as its liver is?

That red globules are found in the lymphatics, and moſt eſpecially in the lymphatics of the ſpleen, is a moſt ordinary occurrence, and quite intelligible. There are not found any where, not even in the ſpleen, imperfect globules advancing in their organization; on the contrary, thoſe which we do find are full formed globules which have been forced out of the common line of the circulation; they are extravaſated, and taken up by the abſorbents before death; or they are ſqueezed into them by handling after death. If we want to have an example of the firſt, we have but to inflame a part and tie up its lymphatics, and then many red particles are found in them; the ſecond we ſee every time we either look for, or prepare the lymphatics of the ſpleen, or of any other ſoft viſcus; for by handling and ſqueezing, the blood paſſes through the ſmall breaches occaſioned by this violence into the lymphatics; if we allow the part to ſpoil, then air is generated, and, by handling it, air paſſes into the lymphatics in the ſame way.

But the ſpleen is eſſential to finiſh the work; it makes the veſicles, and has cells for the buſineſs; and yet this part, which has the moſt important of all offices, viz. that of organizing the general maſs of blood, is every day cut out from Dogs and other animals,

mals, and they never feel the loſs, nor decline in health. There is not the ſmalleſt doubt that the ſpleen has protruded at wounds, and been ſtrangled, and ſo cut off. Every day we find it more or leſs diſeaſed; ſometimes it has ſwelled to thirty or forty pounds; ſometimes it has been reduced to an extremely ſmall ſize; ſometimes it has been found like an empty bag.

In the fœtus, as in a Chick for example, red blood circulates in great profuſion long before its lymphatics, ſpleen, or thymus, can be ſeen to exiſt; whereas, on the contrary, ſince the Chick is inſulated, and has no red blood from the mother, the ſpleen ſhould have been firſt coloured, and all the red blood of the ſyſtem ſhould have emanated from the ſpleen.

It is but a poor evaſion to ſay, in anſwer to theſe objections, "ſome other part may perform this office of the ſpleen." What other parts will perform the office of the liver, if it be wanting? or of the kidney, or of the teſticle, or of any other gland? or will the teſticle ſecrete urine, or the kidney ſecrete bile? What gland, then, will be able to perform ſo peculiar an office as this of adding veſicles or coverings to the central parts of the blood.

After all this long dream about the veſicles and their central parts, the beſt phyſiologiſts of the preſent day ſeem to deny that they exiſt.

But one author has finiſhed this career of uſeleſs ſpeculation, by maintaining that the LIFE is in the BLOOD: and thus we have ſeen this ſimple and beautiful ſubject of the blood tortured through all kinds of imaginations, and running its fiery ordeal, firſt through mathematics, then through anatomy and all its glands, then through metaphyſics; till at laſt we are come to talk with the moſt perfect eaſe and confidence about the moſt monſtrous of all abſurdities, the life of the blood.

"For in the blood is the life thereof," might be a uſeful doctrine among the Jews, if it moderated their deſire for blood; and if among phyſicians this were to be the tendency of ſuch a doctrine, it were very cruel and unnatural to diſturb it: but, in ſerious earneſt, it introduces into modern phyſiology nothing but a jargon of words, and perverts every idea that the mind of man can form of parts which excite and parts which act. Whimſical theories creep faſter into phyſic than uſeful facts; and the buſineſs is fairly enough begun when ſurgeons, diſſecting aneuriſms of the carotid arteries, and who ſhould be employed in recording how and from what cauſes they have ariſen, or how ſuch diſeaſes affect the arterial coats, chooſe rather to inform us "that this ſtate of the blood, or rather of the coagulable lymph, may ariſe from ſome connection or ſympathy it may have with the diſeaſed ſtate of the artery." "By lightning (ſays a celebrated author), death is ſo inſtantaneouſly produced in the muſcles, that they cannot be affected by the ſtimulus of death." Connections, and unknown ſympathies, and living powers in fluids, and energies, and efforts, and intentions, and "ſympathetic congelations in the blood," and "immediate ſympathetic contiguous harmonies of cut parts," and the "diffuſed principle of life," and "the ſtimulus of death;" are words which phyſiology would gain by loſing, and are the very cant belonging to the doctrine which I propoſe to refute.

It is not merely the doctrine of a living principle exiſting in the blood that is now to be ſpoken of, but a doctrine attributing the life of the ſolids to this living principle of the blood; ſo that it may be intitled "the new theory concerning the blood, which is itſelf alive, which gives life to all the other parts, and which in the beginning forms all the parts out of itſelf in the mother's womb;" ſo that a fœtus is merely a ſpeck of blood, and all the parts being formed from that ſpeck of blood, the whole of phyſiology is abrogated henceforward, and totally annulled, except this theory itſelf. It is like the ſtaff of Moſes converted into a ſerpent, which ate up the ſerpents of all the magicians who had thrown down the ſtaff before him; for if this theory were once eſtabliſhed, there would remain nothing to be done in all the animal body but what was done by the blood; nothing to wonder at, nothing to gueſs about, nothing to ſtudy, but this vital and plaſtic power of the blood.

The author of this doctrine ſhows us two or three ſpecks in an incubated egg; he tells us that they are dots of blood; he tells us that this blood forms the veſſels in which this blood itſelf is to move; it forms the limbs of the Chick which theſe veſſels are to ſerve; the bones, muſcles, bowels, glands, the whole creature is formed out of it; and when the bird is delivered from the egg, the living principle of the blood ſtill continues to ſupport it. The blood heals its fleſh or bones when they are broken; "the blood moves in the living ſolids, which it both forms and ſupports."

It is not eaſy to ſay on which of all his proofs Mr. Hunter chiefly relies for eſtabliſhing a doctrine ſo important as this is; whether he conſiders it as a perfect proof of the vitality of the blood that it coagulates, or that this coagulum has moreover the power of becoming perfectly alive, and of forming new veſſels within itſelf; or that blood ſeems to aſſiſt the union of contiguous parts; or that by taking away its blood a creature dies; or that a limb falls into immediate gangrene when its veſſels and its ſupply of blood are cut off. But chiefly he ſeems to rely on coagulation as a proof of the vitality of the blood; for he conſiders the coagulation of the chyle as a proof that it alſo is alive; and he ſays, "contraction is the life of the ſolids; and if we can find any thing like it (by which he means coagulation), we ſhall call it the living principle of the blood."

But what harmony he can find betwixt the occaſional, voluntary, regulated, contractions of the living ſolid, and this ſudden, irretrievable, inorganic, coagulation of the blood, I cannot conceive. Does not jelly coagulate; and what is it but a part of the blood? Does not glue congeal, diſſolve, and congeal again, yet what is it but an animal jelly? Does the blood itſelf ever congeal till it is out of the body, or extravaſated in aneuriſmal ſacs? When it is out of the body, it coagulates; when it coagulates, it is dead: coagulation is ſo far from reſembling the contractions of the living body, that it is the marked character of dead animal matter, which you melt and coagulate again and again. Shall we then define life by ſaying, coagulation is the mark of the vital principle?

ciple? If ſo, we give the mark of its death as the proof of its living power.

But in his awkward attempts to prove this point, the author has brought himſelf into great ſuſpicion, and of courſe into great diſhonour, by two experiments, in which he endeavours to ſhow how this vital power, like the life of a perfect creature, is affected by cold firſt. In page 79, we are informed, that a freſh egg, in conſequence of being alive, reſiſts the cold, and is frozen with great difficulty; but being once frozen and thawed again, it loſes its living principle and its power of reſiſting cold at once; it freezes now at the ſame temperature with other animal matter, ſhowing no longer any power of generating heat, or reſiſting cold.

But we are told *, that the blood having a determined period for coagulating, you may, during that time, freeze the blood, and it will thaw again, and yet congeal at its proper time; and he tells us, that he had very cleverly frozen blood in the very time of its flowing from the vein, then thawed the cake, and ſtill in due time it congealed. Now ſince the egg reſiſts cold by its living principle, why did it die or loſe that living principle when converted into ice? or rather, ſince the blood coagulates through its living principle, and by a living effort, how did it preſerve its living principle after being frozen? This proves ſurely, either that the blood's coagulation has no relation to any living principle, and therefore is not affected by the cold; or that the egg has a living principle of a very different kind, which is abſolutely

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* Page 87.

and totally extinguiſhed by cold. I am ſure, that had Mr. Hunter ſeen theſe two experiments brought face to face in this manner, he would have put one of them at leaſt back quietly into the portfolio from which they both came. I have always obſerved, that your great tellers of experiments need to have good memories; and I am come to look on a ſuite of experiments as coolly as upon a ſet of neat plans and figures by which the author chooſes to illuſtrate his hypotheſis.

That this coagulum, being once formed, has the power of becoming more perfectly alive, and forming veſſels within itſelf, it is not eaſy to conceive. Nothing indeed is more common than clots of blood, or depoſitions of the coagulable part, becoming highly vaſcular, by veſſels ſhooting into them from ſurrounding parts; but this is of no value in Mr. Hunter's doctrine; this is not the fact which he means to ſpeak of; this is much too natural and eaſy for him: and that his meaning may neither be miſrepreſented nor miſtaken, I quote his words; "When new veſſels are formed, they are not always elongations from the original ones, but veſſels newly formed, which afterwards open a communication with the original." That a clot of mere blood ſhould have in it a living principle, and ſhould poſſeſs through that principle the power of forming within itſelf arteries and veins, a new and independent circulation; that it ſhould have the privilege of knowing when it ſhould exert itſelf thus, is really wonderful; that it ſhould have ſome kind of intelligence, or conſciouſneſs, by which it could underſtand when it were within and when without the body; and whether in certain circumſtances it were fit that ſuch veſſels ſhould be formed! That clots ſhould have been buſied forming veſſels within them for ages, and no body ever have ſeen the proceſs going on! That Mr. Hunter, who has been looking out for vaſcular clots for thirty years, never ſhould have ſeen this phænomenon is all very ſurpriſing. Mr. Hunter falls into a deeper blunder in this buſineſs than in the affair of the frozen egg; he abſolutely never ſaw a proper vaſcular clot. He informs us moſt deliberately in page 92. "that he thinks he has been able to inject what he ſuſpected to be the beginning of a vaſcular formation in a coagulum, when it could not derive any veſſels from the ſurrounding parts." From whence then did this clot derive its injection? this is a queſtion which detects at once what Mr. Hunter was doing, and puts this experiment pretty much upon a footing with the frozen egg.

To ſay "that the blood, in ſome circumſtances, unites living parts by a ſort of contiguous ſympathy as certainly as the yet recent branches of one tree unite it with another," is to put forth a ſyllogiſm, in which both major and minor propoſitions are untrue. Firſt, it is not true, that it is the juices of the tree which unite the graff to the ſtock; it is the living fibres, and the living veſſels of both; and unleſs both be alive, the proceſs muſt fail, living juices would do no good. Secondly, though the juices did ſo unite or glue together the branches of a tree, that were no proof of the juices being alive; but only that good juices, whether alive or not alive, were neceſſary to the proceſs.

Any man who affirms that in ſurgical operations it is the blood, " that by a contiguous ſympathy unites the parts," ſhould have ſupported his aſſertion by this further argument, that without blood they will not unite. Prove to me only that freſh cut parts are not alive, and cannot naturally unite without the aſſiſtance of ſome foreign power, and then I will acknowledge willingly that they are altogether beholden to the intermediation of the blood, with its living principle, and ſympathy of contiguity.

But it is very ſingular, that any perſon, even the leaſt inſtructed in forms of reaſoning, ſhould have advanced this as any proof of living principle in the blood, " that mortification immediately follows where the circulation is cut off;" for this proves merely, that the blood is one of many ſtimuli, by which the ſyſtem is ſupported, in ſo much, that each limb is affected juſt as the whole body would be; and whether you ſtop the blood, which is one ſtimulus, or take away its heat, which is the ſtimulus next in power to the blood, the limb will equally die.

To ſay that the life is in the blood, becauſe the blood being taken away the limb dies, or becauſe an animal may be bled till it dies; what is this but to jumble all diſtinction of cauſe and effect? The water, no doubt, is the life of the mill, and the plough-horſe is the very life of the plough; for the mill and the plough are dead the moment that the horſe is gone or the water fails.

Laſtly, we are told " that it is by the contiguous ſympathy of the blood and body both being alive," that they both work upon each other mutually: but is it not very ſtrange for any phyſiologiſt to forget, that the blood is at leaſt in part a foreign body, that it muſt be continually impregnated with air, that it is neither its original conſtitution, nor theſe preſumed ſympathies that make it vital blood, that it becomes vital blood only by expoſure to air, and that if this foreign principle be not continually added, the ſolids are not wrought upon by the blood?

The natural difficulties of this doctrine are very great; for it ſeems to be againſt all the laws of nature that any fluid ſhould be endowed with life. A fluid is a body whoſe particles often are not homogeneous, have no ſtable connection with each other, change their place by motion, change their nature by chemical attractions and new arrangements; a body which can have no perfect character, no permanent nature, no living powers connected with it. But the definition of a ſolid is the reverſe of this: a ſolid among every kind of metals, earths, or foſſils, is recognized by its peculiar form and arrangement of parts: and in the animal body, the arrangement of particles gives the permanent unchanging character of each part; and in the muſcles, for example, or in the nerves, where feeling and irritability chiefly reſide, the form and mechaniſm of the ſolid is in each moſt peculiar, and is always the ſame.

What is this blood that it ſhould begin life and ſupport it, and diſtribute it through all the ſyſtem? Is it not a fluid which varies every hour, now richer, now poorer, now loaded with ſalts, now drowned in

ſerum,

ſerum, now much, now ſparingly ſupplied with air, now darker coloured, now red, now fully ſupplied with chyle, and now ſtarved of its uſual ſupply? Is it not loſt in aſtoniſhing quantities in hæmorrhagies, and drawn very freely from our veins upon the ſlighteſt diſeaſe? That ſuch qualities are conſiſtent with life in the blood, is what I cannot believe. But I can moſt eaſily imagine how the ſyſtem, having by ſucceſſive operations converted the food into chyle, th chyle into blood, and faſhioned the nutritious part o the blood into various ſolids; theſe new ſolids ma partake of the vitality of all the parts to which the are applied, and to which they have been aſſimilated b ſo peculiar and ſo ſlow a proceſs.

The queſtion is plainly this: Shall we follow the general laws of the ſyſtem, ſuch as phyſiology acknowledges? or ſhall we admit an abſurd novelty withou proof? Shall we allow of the ſimple accident of coagulation (an accident common to dead fluids) as a proo of life? or ſhall we forget thoſe ſtupendous proofs o the irritability reſiding in the heart, muſcles, and othe forms of our living ſolids, and which is the ſource o all the various actions of the body? Shall we forge that polypi, worms, inſects, the bloodleſs parts o fiſhes, the uncoloured parts of the human body, eve plants almoſt inanimate, all partake of life, withou having red blood in their ſyſtem, or having it reſtricte to the central parts? All theſe have life and vitality. but where is their blood? In ſhort, the queſtion plainl reſolves itſelf into this, Shall we have two living parts fluid and ſolid; two agents acting on each other? o ſhall we follow the common law of the œconomy, cal

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the one an exciting power, while the other receives that excitement, being alive only that it may feel and act according to the degree in which it is moved? Shall we have the blood communicating life to all the body? or the body only alive, and the blood, like various other excitements, acting upon it with thoſe powers which it is continually acquiring, without acquiring along with them any ſhare of life?

But Mr. Hunter, ill contented with his doctrine himſelf, he even who began with giving to the blood a vital principle, and calling it the former of new parts, and the ſubſtance whence the living ſolid derives its life, hatches a new doctrine out of the confuſion of the firſt; takes from the blood all thoſe high privileges in the ſyſtem which he had ſo freely beſtowed upon it, and gives them in full perpetuity to a new principle, a principium vitæ diffuſæ, which he announces thus:

"I would conſider that ſomething ſimilar to the ſubſtance of the brain is diffuſed through the body, and even contained in the blood; and between this (viz. the matter diffuſed in the blood) and the brain the communication is kept up by nerves." This matter he does not like to define, but he muſt name it; and having obſerved, as others have done, that a mouthful of nonſenſe ſounds infinitely better in Latin than in our mother tongue, he calls it the "Materia vitæ diffuſa."—Concerning this diffuſed principle of life he tells us, that every part of an animal has its due proportion; it unites all the body into one; "it is as it were diffuſed through the whole ſolids and fluids, making a neceſſary conſtituent part of them, and forming with them a perfect whole."—The terms in which this doctrine is propoſed are hardly more intelligible than thoſe in which he argues about the life of the blood; the matter itſelf, reſembling the ſubſtance of the brain, is ſuppoſed! the manner of its union with the blood, is ſuppoſed! its connection at once with the fluids, and with the living ſolids, is ſuppoſed! the ſort, of a manner, in which this matter harmonizes the whole, is ſuppoſed! and now the coagulation, and life of the blood, is no longer an effort of the life of the blood, but of the materia vitæ diffuſa; and the blood does not form the ſolids, the blood no longer communicates life to the ſolids, but the blood and the ſolids are both at once animated by this DIFFUSED PRINCIPLE OF LIFE.

No one need triumph over a doctrine which thus falls by its own weight; but this muſt not be forgotten, that the doctrine of the life of the blood leads to a mean contracted narrow view, not merely of this but of higher ſubjects.

Plants have active and irritable fibres; by the moſt curious actions they drink in water; water alone they can convert, by the moſt ſimple mechaniſm, into the moſt delicate perfumes, into delicious fruits, or into terrible poiſons. "There ſtands," ſays Blumenbach, "a hyacinth before me; generations of theſe flowers, of which this is the laſt, have grown there ſucceſſively, touching the ſurface merely of a little water;" but ſhall Mr. Hunter perſuade me that this water is alive? "vel hyacynthi me monent.*"

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[*] Page 27.

I think I may ſafely conclude, that theſe theoriſts have done the ſcience no good; themſelves no honour; and us no kind of benefit, unleſs it be an advantage to know that by none of theſe ways can we arrive at a knowledge of the blood.

QUALITIES OF THE BLOOD.

Blood is a fluid of a rich and beautiful colour; it is vermilion-coloured in the arteries, ſtrong purple in the veins, and black, or almoſt ſo, at the right ſide of the heart; it feels thick and unctuous betwixt the fingers, is of a ſlightly ſaline taſte, is various in various parts of the body, in the heart or at the centre of the circulation different from what it is in the glands, excretories, and all the extremities of the body; different in the liver, among the inteſtines, in the cheeks, and lips, in the reſervoir or ſinuſes of the head and womb. In various individuals, but much more in different animals, it varies with their functions and manner of life; it is more or leſs perfect in animals, in birds, in fiſhes, in inſects; it is thick or thin; has groſs particles or ſmall; is red or pale; hot or cold; according to the creature's life: and from this laſt variety, viz. of the manner of life, comes our diviſion of animals into thoſe of hot and cold blood.

It is by the moſt ſimple and natural methods that we examine the blood; ſince almoſt ſpontaneouſly it reſolves itſelf into three parts; the CRASSAMENTUM, the SERUM, and the RED GLOBULES; for in a cup of blood the craſſamentum, or clot, the hepar ſanguineum, as it was called long ago, floats in the ſerum;

the red globules are engaged in this clot, and give it colour; the ſerum may be poured off, the coagulum may be waſhed till it is freed of the red parts of the blood; and then the red particles are found in the water with which the coagulum was waſhed, and the coagulum remains upon the ſtrainer, little reduced in ſize, pure and white, the gluten or fibrous part of the blood. Or we may ſeparate this part by a method which Ruyſch firſt taught us; we may, while the blood is congealing, ſtir it with a bunch of rods, when the pure and colourleſs gluten gathers upon the rods and the ſerum, with the red particles ſuſpended in it, remains behind.

OF THE RED GLOBULES.

The red globules, as we have obſerved, are not univerſal; yet in all creatures, even in colourleſs inſects, there ſeem to be formal particles in the blood; in white inſects, they are white, in green inſects they are green, in moſt inſects they are tranſparent.

The red globules of the human blood are eaſily ſeen; they are beſt examined with a ſimple lens, the globules being diluted in ſerum, and laid upon an inclined plain, not in water, which diſſolves them quickly, but in ſerum, which has the property of preſerving their globular form.—The ſize of the particles of the blood varies in various creatures; in the fœtus, they are bigger than in a grown animal; and although Leeuwenhoek thought it eſſential to his doctrine, to ſay, that they were alike in all creatures, we know beyond a doubt that there are in reſpect to the ſize of the animals the ſtrangeſt reverſes. The Skate has red globules much larger, and the ox has globules much ſmaller, than thoſe of a man. Fiſh have large globules, ſerpents ſmaller ones, and Man ſmaller ſtill. In Man the diameter of each globule is much leſs than the three thouſandth part of an inch.

There is in the effect of lenſes, or in the nature of theſe globules, ſome ſtrange refraction, by which there ſeems a darkneſs in the centre of each globule, and thence a deception which has been univerſal; ſo that no ſingle deſcription has tallied with that which went before. Leeuwenhoek believed that he ſaw them conſiſting each of ſix well compacted ſmaller globules: Hewſon believed that they were bladders, which had within them ſome central body, looſe and moveable; that often the central part might be ſeen rolling in its bag; and that ſometimes the bladder was ſhrunk and ſhrivelled around the central body, and could, by putting a drop of water upon it, be plumped up again. The Abbé Torre examined them with ſimple lenſes too; but they magnified ſo highly, that from this cauſe all his noiſy miſtake has ariſen; for he uſed not ground lenſes, but ſmall ſphericles of glaſs formed by dropping melted glaſs into water: they magnified ſo much, that to him the central ſpot appeared much darker; he ſaid that theſe were not globules, but rings. He ſent his ſphericles of glaſs and his obſervations from Italy, his own country, to our Royal Society; and for a long while, though nobody could ſee them, ſtill the public were annoyed by Abbé Torre's rings. Falconer, with all the zeal of a friend, publiſhed Hewſon's diſcoveries after he was dead; lamenting, as we all muſt do, the loſs of a promiſing young man. Falconer thought he ſaw theſe globules, not as ſpheres but as flattened ſpheres; he thought he ſaw them often as they rolled down the inclined plane upon which he placed them, turning their edges, their ſides, their faces, towards the eye; he even compared their flatneſs with that of a coin. Many authors have conjectured that theſe globules are compreſſed when they come into narrow paſſages, and expand again when they get into wider arteries. This Reichell ſays he has ſeen, and Blumenbach believes; but Blumenbach, leſs eaſy of belief with regard to all theſe ſtrange forms aſcribed to the particles of the blood, pronounces his diſſent in plain terms. "They appear," ſays he, "to my eye no other than ſimple globules, apparently of mucus: that lenticular or oval form which authors ſpeak of, I have not ſeen."

The following are their chief properties with regard to the reſt of the blood. When blood ſtands, they fall to the bottom, becauſe they are heavier than the other parts of the blood; and although the gluten entangles them while it is forming, ſtill it is to be noticed that the cake is always redder at the bottom; and when by weakneſs or diſeaſe this coagulation is very ſlow, ſome globules eſcape the graſp of the coagulum, and the ſerum is tinged with red, and the cake, though coloured at the bottom, is white at the top, or has the buffy coat. Their form they preſerve only while in the blood, and ſeem to be ſupported more by the qualities of the ſerum than by their own properties; for if mixed with water, they mix eaſily, and totaly diſſolve; the water is red, but the globules are gone; when we mean to preſerve their forms for experiment, we muſt keep them in ſerum, or muſt make an artificial ſerum by impregnating water with ſalts. Their quantity, in regard to the whole maſs, varies ſo, that the appearance of the blood is a real index of health or diſeaſe: in diſeaſe and weakneſs, the blood is poor and colourleſs; in health and ſtrength, it is rich and florid; by labour, red particles may be accumulated in a wonderful degree; in hard working men they abound; they may be accumulated by exerciſe into particular parts, as in the wings of Moorfowl or Pigeons, and in the legs of common Hens. In ſhort, the red globules are numerous in health; in large and ſtrong creatures; and in the centre of the ſyſtem, where they often circulate when (as in fiſhes) all the fleſh is colourleſs; in ſuch a ſyſtem, particular glands only, or viſcera, as the liver, ſtomach, or ſpleen, are coloured with blood, and but a ſmall proportion circulates in the great veſſels round the heart.

The redneſs of theſe particles is a peculiarity for which we know no meaning nor cauſe. The greateſt phyſiologiſts have aſcribed it to the iron of the blood; but when we reflect how many various colours iron gives in its various ſtates; when we reflect, that the unknown cauſe which gives colour to the iron may give colour to the blood; when we reflect, that of this crocus of iron we can hardly procure one poor grain from four hundred grains of theſe red particles of the blood;—we cannot but be conſcious that this peculiarity is not yet explained.

COAGU-

COAGULABLE LYMPH.

The coagulable part, the cake which is left whe
we waſh away the red globules, is by far the moſt im
portant part of the blood, the moſt univerſally di
fuſed in the animal ſyſtem, the moſt neceſſary for th
ſupply and growth of parts. It forms all the ſolid
and in its properties reſembles them moſt curiouſly
for this cake, when waſhed, is white, inſipid, extremel
tenacious, and very fibrous; can be drawn out greatly
and it is the coagulation of this part that makes th
long fibrous ſtrings which we find in the tub whe
bleeding a patient in the foot in very hot water. Bein
ſlightly dried, it ſhrinks into a ſubſtance like parch
ment; being hardened by heat, it becomes like a piec
of horn or bone; when burnt, it ſhrinks and crackle
with a very fetid ſmell, like the burning of feather
wool, fleſh, or any other animal ſubſtance; by whic
we know it to be the part of the blood which is th
moſt perfectly animalized, and the moſt ready to b
aſſimilated with the living ſolids. When diſtilled, i
gives ammoniacal ſalt and alkaline water, and a ver
thick heavy fetid oil, and much mephitis, which ar
the marks of the moſt perfect animal nature; and afte
burning it, the reſiduum is a phoſphate of lime, or, i
other words, the earth of bones.

Its peculiar properties, as it appears in the blood, ar
few; its relation to the body is very ſurpriſing; how
the body acquires, and how it applies, this moſt im
portant part of the blood, we ſhall next explain.

They

There is no part of our food which does not contain this gluten in a large proportion. With regard to animal food, this is to be remembered, that except the fat and the earth of bones (which is in a wonderfully ſmall proportion), the whole is gluten. A piece of animal food we can firſt waſh clear of its blood till it be colourleſs, and then boil with a ſtrong heat till it is converted into jelly merely. Eggs contain an animal gluten ſeparated and entirely formed; the final uſe of which is to enter into the inteſtines of the chick, and nouriſh it. Milk contains in its curdy part a perfect gluten, which is eaſily ſeparated, and when perfect coagulates with acids like blood. Oyſters, ſhell-fiſh, fiſhes of all kinds, are ſo entirely formed of gluten, that many of them can be boiled down to a perfect jelly. With regard to our vegetable food, this is to be remembered, that much of it is already formed into gluten, and is ready to be aſſimilated into an animal nature. If we knead up flour with cold water into a cake, the waſhing of that cake reſembles the proceſs of waſhing a coagulum of blood; for while we hold it in our hand, and pour cold water upon it, the water as it runs off carries along with it a white amylaceous matter, which is ſtarch; along with this there is much ſaccharine and mucilaginous matter; but the moſt denſe and ſolid part of the cake remains in the hand. This is the gluten of the vegetable left alone, juſt as the gluten of the animal is waſhed pure of the red blood; and this vegetable gluten is very tough, ſo that the whole cake may be drawn out into one long ſtring. It is ſo tenacious and ſo hard when dry, that it has been long uſed as a cement; and it ſo preciſely reſembles the animal gluten, that, put them together, and you can ſee no diſtinction. It ſhrinks alſo with heat, and is converted into a ſubſtance like parchment or horn. It firſt melts with heat, and then burns like feathers or hair; and by diſtillation it gives only alkaline ammoniacal ſalts and fetid oils; it wants no mark of perfect analogy with our animal gluten, and we can be at no loſs to think whence all our neceſſary ſupplies ariſe: and flour, though it is the richeſt, in this highly nutritious part ſcarcely exceeds corn, barley, potatoes, peaſe and beans, and all thoſe vegetables called legumina, upon which chiefly we depend for bread, or a ſubſtitute for bread. Theſe do not, indeed, contain this vegeto-animal matter directly or entirely formed; but they conſiſt of a jelly analogous to all the white or gelatinous parts of the human body; as vegetable jelly, it has a vegetable character, it ferments and becomes acid; while animal jelly, as belonging to the animal body, has other characters, it becomes putrid, and affords alkalis only: but how eaſy this converſion muſt be, I need hardly ſuggeſt.

What paſſes within the animal body, or how this gluten is directly applied, we never can know; but we ſee how all the body is compoſed of gluten, and no analyſis of any ſingle part has ever diſappointed us. A muſcle being ſqueezed, and thorougly cleanſed of blood, waſhed in ſpirits of wine, and again cleaned, is ſeen plainly to be but a peculiar form of coagulable lymph. An anatomical preparation waſhed, and purified as it is, conſiſts of mere lymph retaining its primitive ſhape. A bone being infuſed in any mineral acid, or in vinegar, its earthy parts are diſſolved even to its centre; it becomes ſoft and flexible, ſtill retains the form of a bone; but what remains is merely coagulable lymph. And though Fourcroy is certainly right in ſaying the coagulable lymph is that part upon which nature fixes irritability or the contractile power, he ſhould have added, " but this gluten is moreover in the animal body the baſis of every part which poſſeſſes life;" it conſtitutes, in truth, no leſs than nine-tenths of the ſolids of the whole body. The membranes, ligaments, tendons; perioſteums, and all the white parts of the animal body, conſiſt entirely of this; and it is the buſineſs of cookery to boil them down into this jelly. It is this fibrous part, then, which is ſecreted by the veſſels for repairing all the waſtes and all the accidents of the body; when a muſcle is waſted by violent action, or by fevers, or by long confinement is abſorbed, gluten is ſecreted to fill it up; when a bone is broken, much of this jelly is depoſited in a bed for veſſels to ſtretch into, and a new bone is quickly formed; when ſoft parts are cut, gluten is poured out betwixt them; when viſcera are inflamed, pure gluten, white, and membranaceous-like, is poured out betwixt them; when the uterus is to be prepared for receiving the impregnated ovum, gluten is poured out into the womb; and in all theſe caſes it is the foundation of a union with the ſurrounding parts. In ſhort, this gluten forms, nouriſhes, ſupports, reſtores the parts of the animal body; but far from conſidering it either ſimply, or along with red globules, as containing the principle of life, I find it as perfect in dead vegetables as in living animals; and view it only as that particular form of matter which nature has wiſely appointed for our chief nouriſhment and ſupport *.

THE SERUM.

The ſerum is the thinneſt and moſt fluid part of the blood, which dilutes the other parts, and receives all thoſe extraneous ſubſtances which often circulate in our ſyſtem: this muſt be kept in view when its properties are to be told, for though it ſo exactly reſembles the white of an egg, that ſome have in comparing

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* It will eaſily be perceived, that here I chooſe to ſink, in this general deſcription, all thoſe leſſer diſtinctions which are ſo imperfectly proved. Diſtinctions betwixt the gluten and the albumen or ſerum in animals, or betwixt the vegeto-animal gluten and the ſtarch in vegetables, I hold to be very vain; theſe are but various ſtages of the ſame product; what is leſs perfect in the albumen, is more perfect in the gluten; and a little more or a little leſs of the oxygene or acidifying principle, makes perhaps all the difference: theſe parts, as they are more or leſs perfect, contain more or leſs of this principle, and are more or leſs ready to congeal; both kinds of jelly, when treated with nitrous acid, give out azotic gas; azotic gas, united with hydrogene gas, forms the volatile alkali; and the giving out of this azotic gas to nitrous acid, or the forming of the volatile alkali in the act of putrefying, are the chief teſts by which animal matter is known. Then to make formal diſtinctions betwixt the tendinous and the fleſhy parts of animals, and to call the firſt gelatinous and the latter glutinous parts, as formed of the proper gluten, ſeems very vain; and not leſs ſo to make eſſential diſtinctions betwixt the gelatinous parts of vegetables and thoſe of animals, ſince the ſlight change of proportion of azot or oxygene muſt make the whole difference when theſe vegetable jellies are aſſumed into the living ſyſtem and completely analyſed.

paring the two, written whole pamphlets upon the ſubject, and named it the Albuminous Fluid, although it coagulates like gluten, although it putrefies like fleſh, although it gives out upon diſtillation ammonia and a black and fetid oil; yet it is moſt natural that along with theſe it ſhould contain alſo ſome foreign bodies, as a ſaccharine or extractive matter, belonging to vegetables, and ſome proportion of the oxalic, malic, or other vegetable acids.

Serum or the albuminous fluid is like whey, of a yellowiſh, or rather greeniſh colour, of an unctuous or ſlippery feeling among the fingers; it is ſlightly ſaline, and its ſalt is chiefly of an alkaline nature; it contains ſoda completely formed, by which it turns vegetable reds to green; it coagulates firmly with a heat much lower than that which makes it boil; being dropped into hot water, it coagulates as it falls; by 150 degrees of heat it coagulates into an albumen like the white of an egg; but if gradually evaporated, the cake which remains is quite ſimilar to the gluten of the blood. It is upon this alkali that the fluidity of the ſerum ſeems to depend; ſpirits of wine do indeed ſeem to congeal the blood, but it is not a true coagulation, ſince it depends merely on the avidity of ſpirits for water, by which the ſpirit of wine takes the water to itſelf, thickens the ſerum, and makes the whole turbid; but acids produce a true coagulation by ſeizing that alkali on which the fluidity truly depends.

To ſay that lime coagulates the ſerum, but melts down the lymph, is by no means to eſtabliſh a rational diſtinction betwixt the cake of gluten and this gluten which the ſerum holds diſſolved: till ſome deciſive difference be proved important to the whole ſyſtem, I cannot but believe that they are one; nor can I, when I ſee the water which waſhes the coagulum impregnated with gluten, believe that there is any difference. Yet we need not wonder that ſuch ignorant unmeaning diſtinctions as theſe ſhould have been made, ſince the halitus of the blood, or that vapour which riſes from it while it cools, was examined with a moſt ludicrous affectation of accuracy, though it is merely water alone, having a ſlightly urinous ſmell, from its connection with the blood.

The ſerum dilutes the whole maſs, and no other fluid can we find ſo fit to hold in ſolution a proportion of gluten, or ſo fit to ſupport the form of the red globules, or ſo fit to paſs eaſily and ſmoothly along all the delicate veſſels, without exuding through the pores. For in truth it is with the ſerum as with our injections; if we inject ſimple water, it exudes at every pore, and the whole cavities are filled, and the whole body ſwelled and bloated; but when we mix ſize, *i. e.* gluten, common glue, with our water, it penetrates to the extremeſt parts, yet ſtill keeps in the channels of the arteries, and often returns by the veins.

The whole fabric of the blood ſhould now be expoſed in one continued view, conſiſting of three diſtinct parts, whoſe uſes are theſe:

Firſt, we ſee the SERUM diluting and tempering the whole, preſerving its lubricous and fluid form, containing and diſſolving all foreign matters which may have got acceſs to the ſyſtem, and running them off by various excretories; for the ſecretions are chiefly from the ſerum, containing gluten enough to ſupport the tenuity of the blood, ſalt enough to keep the red globules in their form, and conveying alſo a ſufficiency of lymph into the moſt delicate and bloodleſs parts of the body: and this above all is a moſt ſingular property of the ſerum, that it admits freely the air to paſs through and impregnate the blood; for when the coagulum of the blood is drowned deep in its ſerum, if turned up and expoſed to air it reddens; which, if oil, mucilage, water, or any other fluid, be ſubſtituted inſtead of ſerum, it will not do.

Next, we ſee the red globules of large diameter, but in quantity very ſmall, *i. e.* in proportion to the whole ſyſtem; of large diameters, that they may not go into the very minute veſſels, and in ſmall quantities, becauſe they are accumulated round the heart and in the greater veſſels.

And, laſtly, the gluten is the moſt important part of the blood; that which, being diſſolved in the ſerum, pervades even the moſt exquiſite veſſels of the ſyſtem; the part from which all our ſolids are formed, and into which all our ſolids, and even fluids, can be reſolved. But allowing for the various proportions of the water which dilutes the ſerum and the red globules (whoſe proportion to the fluids cannot be named it is ſo ſmall), and ſome ſaccharine or extractive matter which is in the ſerum of the blood—what is there except gluten in all the animal ſyſtem? Serum, coagulum, fleſh, tendons, ligaments, bones, all are compoſed of it; and when gluten is thus united to the ſolids, forming with them one individual body, it acquires new powers, and is indeed alive.

This analyſis of the blood contains the analyſis o almoſt all the humours or ſecretions of the body Obſerve how nearly the urine reſembles the ſerum indeed the urine, like the ſerum, preſerves the peculia form of the red globules, and ſweat is but a ſerun loaded with ſalts; obſerve how little ſaliva differs fron the ſerum; obſerve how perfectly the ſerum reſemble milk, ſince mixing ſerum with water produces a milk fluid, that is, a fluid which gathers cream on the top and coagulates with acids and heat. The water o dropſies is purely ſerum; the mucus of hollow paſ ſages is little elſe than inſpiſſated ſerum; the bile it ſelf is ſaid to be imitated by keeping putrid blood In ſhort, it is obvious that on the coagulable lymph depend all the internal ſecretions, *i. e.* for ſupplyin the waſtes of the ſyſtem, for enabling it to grow, fo repairing bruiſed or cut fleſh, or broken bones; tha on the ſerum which dilutes the blood, and contain all ſuch foreign bodies as might be injurious to th ſyſtem, all the excretions, as urine, ſweat, ſaliva tears, &c. &c. depend *.

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* When the blood and ſolids of animal bodies come to be r ſolved into their ultimate parts, we find a variety of combinatio which belongs to another ſcience, and which in this place it we tedious to explain. But ſtill there is one great diſtinction betwi animal and vegetable matter, which ſhould not be left unnotice Animal matters always, when diſſolved by nature, fall into a pu trid ſtate, and give only volatile alkali. Vegetables, when the diſſolve, fall into fermentation, and produce acids or wine; n that alkalis are neceſſarily contained in their formal ſtate in th animal body, but that the animal body contains much mephit or baſis of nitrous air, which, combining with the inflammab air afforded by decompoſed water or by their oils, forms the v latile alkali.

I have ſaid, " that the blood is a fluid of a rich and beautiful colour; vermilion-coloured in the arteries, ſtrong purple in the veins, and black, or almoſt ſo, at the right ſide of the heart." When we open the thorax of a living Dog, the lungs collapſe, the heart ſoon ceaſes to play, the Dog languiſhes, expires, is revived again when we blow up its lungs:—then begins again the motion of the heart, the black blood of the right auricle is driven into the lungs; the blood goes round to the left ſide of the heart of a florid red; and this purple blood of the veins, the vermilion blood of the arteries, the change happening ſo plainly from acceſs of air, is a phenomenon of the moſt intereſting nature, and binds us to look into the doctrines of chemiſtry for the ſolution of a phenomenon to which there is in all the animal economy nothing equal.

It is the ſtudy of air and aërial fluids that has brought to light all the beautiful diſcoveries of which modern chemiſtry can boaſt. The ſimplicity of the facts in chemiſtry, the correctneſs of the reaſoning, the grandeur which now the whole ſcience aſſumes, is very pleaſing; and makes us not without hope, that by this ſcience, all others, and ours in an eſpecial manner, may be improved; for the action of veſſels will do much in forming and changing our fluids: all the reſt is chemiſtry alone.

The older chemiſts were coarſe in their methods, bold in their conjectures, in theory eaſily ſatisfied with any thing which others would receive. They condeſcended to repeat inceſſantly the ſame unvarying proceſs over each article of the materia medica; and among hundreds of medicinal plants which they had thus analyſed, they could find no variety of principles, nor any other variety of parts and names than thoſe of phlegm, and oil, and alkali, and acid, and ſulphur, and coal. By this they diſburthened their conſciences of all they knew, pleaſed their ſcholars, and ſet the phyſicians to work, forming magnificent theories of ſalts, ſulphurs, and oils; for ſuch has ever been the connection of chemiſtry with phyſiology, that, good or bad, they have ſtill gone hand in hand.

The older chemiſts thought that they had arrived at the pure elements, while they were working groſsly among the groſſer parts of bodies. They could know nothing of the aërial forms of bodies, for they allowed theſe parts to eſcape. When their ſubjects, by extreme force of heat, roſe upwards in the form of air, no further inveſtigation was attempted; it was ſuppoſed that the ſubject of their operation was conſumed, annihilated, waſted into air, and quite gone. When they thus ſtopped at airs, they ſtopped where only their analyſis became intereſting or ſimple; ſtopping where they ſtopped, among their oils and ſulphurs, they made their ſcience a mere rhapſody of words. Philoſophy they conſidered ſo little, as not to know that the lighteſt air is really a heavy body, and that with weight and ſubſtance other properties muſt be preſumed.

Modern chemiſtry begins by aſſuring us, that theſe airs are often the denſeſt bodies in the rareſt forms; that airs are as material, as manifeſt to the ſenſes, as fairly ſubject to our operations, as the denſe bodies from which they are produced: That it is heat alone (a ſubſtance which irreſiſtibly forces its way into all bodies) that converts any ſubſtance into the aërial form: That ſome bodies require for their fluidity merely the heat of the atmoſphere, and ſo cannot appear on this planet in any ſolid form: That others require ſome new principle to be added, in order to give them the gaſeous or aërial form: That others require very intenſe heat to force them into this ſtate; but that all aërial fluids ariſe, or muſt be preſumed to ariſe, from ſome ſolid body or baſis, which ſolid baſis is dilated by heat into an air. The ſolid baſis of ſome airs can be made apparent, as of fixed air which proceeds from charcoal; others, as pure air, or azotic air (the great conſtituents of our atmoſphere), cannot be produced to view into any ſolid form. But thoſe airs which cannot be exhibited in any ſolid form, can yet be ſo combined with other bodies as to increaſe their weight, and give them qualities of a very peculiar nature; and theſe airs can be alternately combined with a body and abſtracted again, adding or abſtracting from its weight and chemical properties, not only in a perceptible, but in a wonderful degree; ſo that theſe abſtractions and combinations conſtitute ſome of the moſt general and important facts. When the old chemiſts, then, neglected to examine theſe airs, they refrained from examining the laſt elements of bodies at the very moment in which they came within their power.

That theſe muſt be the moſt material and important facts in all the ſcience, it is eaſy to explain; for chemiſtry, ever ſince it has been a ſcience, has reſted upon one ſingle point. There are certain great operations in chemiſtry which we perceive to have the ſtricteſt analogy with each other, or rather to be the ſame; the operations are, the combuſtion of inflammable bodies, the reſpiration of animals, the calcination of metals; and whatever theory explains one explains the whole. The older chemiſts obſerved, that when they burnt an inflammable body, the ſurrounding air was contaminated, the ſubſtance itſelf was annihilated, nothing remained of its former exiſtence but the foul air; and they ſuppoſed that this inflammable body conſiſted of a pure inflammable principle, which was the ſubſtance which ſpoiled the air, leſſening its bulk, and making it unfit for ſupporting any longer either combuſtion or animal life. When an animal breathed in confined air, they found the phenomenon ſtill the ſame; the animal contaminated the air, and expired itſelf; left the air unfit for burning or breathing, loaded, as they ſuppoſed, with the inflammable principle. When they calcined a metal (which is done merely by heating the metal and expoſing it to air), they found, as in theſe other operations, the air contaminated, the metal loſing its metallic luſtre, ductility, and all the marks of a metal,—acquiring (in certain examples) new qualities, like thoſe of ſome mineral acid, and becoming of courſe a moſt cauſtic drug; but above all, they uniformly obſerved the metal to increaſe in weight.

To account for all theſe diſcordant changes was the moſt difficult part of all: it was indeed eaſy to ſay, that combuſtion was the giving out of an inflammable principle to the air; and to ſay concerning reſpiration, that it was the buſineſs of the air to take away continually the ſuperabundant phlogiſton of the blood; but how a metal ſhould paſs from a mild to a moſt acrimonious and cauſtic ſtate; and above all, how by the loſs of its inflammable principle it ſhould not loſe in weight, but increaſe in weight! This was the Gordian knot which they had to untie, and which they cut luſtily, betaking themſelves, in defiance of all philoſophy, to the abſurd project of a principle of abſolute lightneſs. They all agreed to call the phlogiſtic principle a principle of abſolute levity; and thus their doctrine ſtood for many years, viz. that when phlogiſton, or inflammable principle, was added to the calx of any metal, as to red lead, by roaſting it with any inflammable body—the metallic luſtre, tenacity, ductility, were reſtored, and the metal became lighter withal, becauſe it now had within it the principle of levity. But that when by heat and air it was calcined, this principle was driven out, and then the metallic luſtre, tenacity, ductility, &c. were loſt by the abſence of the inflammable principle upon which they all depended; but the weight of it was increaſed, for the principle of levity was gone. This is the brief abſtract of the theory to which the very beſt chemiſts have addicted themſelves down to the preſent times.

But the chief perfection of modern chemiſtry is, that its apparatus is ſo perfect, that it can employ exactly a certain quantity of air in calcining a metal; it can collect that air again to the twentieth part of a grain; it can prove whether the metal has really been giving out any inflammable principle to the air, or whether it has received matter from the air, and how much expreſsly it has gained or loſt. Modern chemiſtry proves to us, that it is not the loſs of any principle that endows a metal, for example, with negative powers; but the direct acquiſition of a new principle, which endows it with poſitive powers. Thus if you take a quantity of mercury, and expoſe it ſlowly, that is, for a long time to heat and air, the following changes take place; it gradually loſes its metallic luſtre, the upper part of it aſſumes firſt a yellow and then a red colour, ſmall red particles are ſeen floating on the ſurface of the mercury; and theſe are the mercurius precipitatus per ſe, a moſt acrid calx of mercury. If, firſt, you eſtimate how much air has been expended during the proceſs, you find that the weight of the mercury is increaſed in exact proportion; if you put that calx into a gun-barrel, put the gun-barrel into the fire, and by mere force of heat drive out this air, you find the quantity of air exactly equivalent to the quantity expended in the proceſs; you find the metal grow lighter, and recover its metallic qualities and luſtre in proportion as the air is expelled. In ſhort, we find the metal heavier when combined with air, lighter when the air is driven out; we find it having the qualities of a metal when uncombined with air, when combined with air having the qualities of a calx: then plainly this cauſtic form of the metal is not a negative quality, it is a poſitive one, proceeding from the infuſion of this new principle from the air.

By ſuch proofs as theſe chemiſtry has explained, in a moſt philoſophical way, how all theſe phlogiſtic proceſſes, as they were called, depend, not on the abſtraction of phlogiſton, but on the addition of a new principle: That they all ariſe from one poſitive power, that the ſame principle gives life to fuel, heavineſs (and other effects of calcination) to metals, acidity to acids, and redneſs to the blood. Theſe are all performed by one power; they are all eſſentially one proceſs; they are all effected by the communication of one ſole principle, viz. the baſis of pure air.

Upon our atmoſphere and its ſurpriſing harmony with all parts of nature; with animal and vegetable life; with water, metals, acids, and all the ſolid bodies into which it enters—much more depends than it is eaſy to conceive. Could we have ſuppoſed that it was the cauſe, not merely of life in all living creatures, but almoſt the cauſe of all the properties that reſide in the moſt ſolid forms? Could we have ſuppoſed that the air rendered heavy bodies heavier, changed metals into cauſtic earths, converted many bodies into acids, changed inflammable air into the pure element of water, which at leaſt we have hitherto conceived to be pure? Yet, if there be one word of truth in chemiſtry, all this is true.

The atmoſphere contains various gaſes or airs; but one only, viz. vital air, is uſeful to reſpiration, combuſtion, and animal life; that purer air muſt, like every other, ariſe from ſome ſolid baſis: That baſis cannot be ſhown in any ſubſtantial form, but it can be combined with many various bodies, ſo as to give them an increaſed weight and new qualities; and thence we preſume to ſay, whenever we ſee a body, by ſuch a proceſs, acquiring ſuch qualities, that it acquires them by abſorbing the baſis of pure air; for pure air is nothing but this preſumed baſis dilated into the form of air by heat; and when it combines with any body, it gives out its heat; ſo that in all theſe proceſſes heat is produced. And although inflammable bodies, metals, acids, and animal blood, ſeem very diſtinct from each other; although combuſtion, breathing, calcination, and the forming of acids, are proceſſes ſeemingly very unlike; yet they are in all their eſſential points the ſame, viz. a change of qualities and a production of heat in conſequence of the abſorption of pure air.

Firſt, when an inflammable body is BURNT or conſumed by fire, the baſis of pure air is combining with the combuſtible body; the air is entering into a new combination, and therefore muſt give out its heat; it combines rapidly, gives out its heat rapidly, is waſted; the inflammable body burns and ſeems to be conſumed: but if we catch that air which eſcapes from the inflammable body, we find it to be equal exactly to the whole weight of the air and of the burning body that have been conſumed; and this air conſiſts of two parts, viz. of the ſubſtance which was burnt, and of the baſis of pure air. Thus, for example, when we burn charcoal or carbon, the whole ſubſtance of it, weight for weight, is converted into an air, which is called fixed or fixable air; the ſame which is diſcharged from ſtoves, the ſame alſo which is found in pits, the ſame which oozes through the ground in the Grotto del Cane, the ſame which floats upon the ſurface of fermenting vats, and which is ſo much heavier than common air that it can be taken out from a vat in baſons, and poured from diſh to diſh. Combuſtion, then, is a proceſs which conſiſts in the rapid aſſumption of the baſis of pure air, and a conſequent converſion of the burning body into an air endowed with peculiar qualities and powers.

If, then, the oxygenation of the blood be a proceſs like this, it muſt differ chiefly in degree; it might in certain circumſtances become too rapid, and reſemble an actual combuſtion; and ſo in certain circumſtances it does, for our atmoſphere is ſo tempered that no more than 27 parts out of 100 conſiſts of pure air; the reſt is food for vegetables, but not fit to maintain flame or animal life. This is the reaſon that even burning as well as breathing are ſlow proceſſes, and that an animal, if made to breathe pure air, or vital air as it is called, gets the baſis of air too rapidly united to its ſyſtem, is conſumed and inflamed quickly, and dies.

Secondly, the proceſs of CALCINATION is the ſame in all metals; it alſo is an aſſumption of the pure air, or rather of its baſis, with a change of qualities and increaſe of weight: if you calcine lead ſlowly, it becomes firſt yellow, then orange, then red; it becomes heavier, ſo that from 100 pounds of lead you have 110 pounds of lytharge, or calx of lead: if you calcine mercury, it alſo becomes firſt yellow, then red, and much heavier than at firſt: if you diſtil any of theſe metals, you can by heat merely drive out the pureſt air from them; they recover their brilliancy, and grow lighter, becauſe the baſis of air is expelled. The baſis of pure air is expelled, not in that ſolid form in which it was embodied by the calx, but being

ing now combined with heat, it appears in the form of vital air; the air is much purer than that of the atmoſphere which was uſed in the proceſs, becauſe the metal abſorbs or appropriates to itſelf nothing but the pureſt air, leaving the azotic or foul air behind: and finally, if you wiſh to ſee the harmony betwixt combuſtion and calcination, or to be aſſured that calcination is truly the burning of a metal, take ſome of this pure air, which is three times purer than the atmoſphere, and raiſes an intenſer flame; plunge into it a piece of iron wire, which is made red-hot; and this wire (which would only have waſted or ruſted into a calx in the common atmoſphere) will in the pure air burſt out into a brilliant white flame, and burn entirely while it has ſuch air; nay, ſome metals, as zinc, burn even in our common atmoſphere with a moſt brilliant flame.

From this ſecond proceſs, muſt it not be preſumed that the principle which gives an increaſe of weight and ſuch ſingular properties to various metals, muſt have very intereſting effects upon the blood?

Thirdly, it is from this principle alſo that all acids are formed; and as oxyd is the Greek name for acid, the great Lavoiſier has thought fit to give a name to the baſis of air, or that principle which is obvious only when operating in ſuch proceſſes as theſe. He adds to the Greek name for acid that verb which implies the generation of any ſubſtance; he calls it thus oxygene, or the principle which generates acids. It were eaſy to ſhow how truly this great point is ſupported by all the particular operations in chemiſtry; it ſhall be ſufficient to obſerve a few. When we burn ſulphur in open air, it ſeems to be conſumed; but when we burn it in cloſe veſſels, ſtill giving a free acceſs to air, we find it converted into an acid the moſt ponderous of all, weighing greatly more than the ſulphur from which it was procured. The operation is done in cloſe veſſels; nothing can paſs but what is known, and nothing is more certain than that the whole of this wonderful and rapid change is the mere effect of the ſulphur, which is an acidifiable baſe, aſſuming the acidifying principle by which alone it can become an acid. Phoſphorus being burnt in a cloſe glaſs upon the point of a wire, the vital part of the atmoſphere is conſumed, the azotie air (which the ancients miſtook for their phlogiſton) remains, the whole phoſphorus is changed into phoſphoric acid, and the whole acid when weighed expreſsly equals the phoſphorus which was burnt, and the air which was conſumed along with it. Nay, arſenic, which is a metal, being calcined, is converted into a perfect acid. Thus we ſee, firſt, that calcination is a mere combuſtion, ſince it can be made ſo rapid as to be attended with heat and flame; next we ſee that acidification is, like calcination, attended with heat and flame, and an acquiſition of weight and of properties like thoſe of calces. We ſee ſome metals converted into proper acids; acids and metals mixing in qualities with each other; acids and metals are both acidifiable baſis, both are capable of receiving new and ſimilar properties, by aſſuming into their compoſition the baſis of pure air; and in one ſingle proceſs the whole ſet of phenomena are exemplified, for in burning arſenic we have combuſtion, calcination and generation of acid, all in one proceſs; the product being named indifferently oxyd of arſenic, or white calx of arſenic *.

But if moſt acidifiable baſes be thus forced by combination to forſake their ſolid and aſſume their aërial form, others more ſingular ſtill are recalled from their aërial form, and condenſed into the fluid form of a ſtrong acid. Thus azotic or nitrogene air, which forms the great bulk of our atmoſphere, is converted by oxygenous or pure air into an acid form †; it becomes nitrous acid, nitric acid, nitrous air, ſtrong or weak according to the various degrees of oxygenation communicated to it; and thus nitrous air, by its appetite for oxygene, and by its change of colour and its condenſation, whenever it takes oxygene from the air, makes a eudiometer or meaſure for the purity of the air; and, according to the purity of the atmoſphere, more turbidneſs and more redneſs is produced in the nitrous air, and a greater loſs of bulk, which may be marked on a ſcale.

Thus are all acids formed of an acidifiable baſis, various each according to its kind, on which the variety of acids depends; but theſe all become acid by the addition of one uniform principle, viz. the baſis of pure air,

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* It is neceſſary to add nitre to make it burn. The reſult is not directly an acid, but a neutral ſalt formed of the arſenical acid joined to the alkali of nitre; without the help of nitrous acid it is only an oxyd or imperfect acid; and it is neceſſary to uſe the hyper-oxygenated muriatic acid for communicating to it a ſufficiency of oxygene to conſtitute it a perfect acid.

† *N. B.* It is neceſſary to incloſe them in one veſſel, and to paſs the electric ſpark through them that they may unite.

air, which is the cauſe of acidity in all bodies: and this third great fact in chemiſtry may well ſuggeſt to us a higher view of our preſent ſubject; for this principle, which beſtows weight and cauſticity on metals, acidity on acid baſes, and new properties on all it touches, muſt make ſimilar, or at leaſt important, changes on the blood, converting it into an oxyd or ſubacid; and we may fairly begin our next general fact under the title of the oxydation or oxygenation of the blood.

The oxydation of the blood makes a fact no leſs important in phyſiology than thoſe are in chemiſtry; for as there are various marks of the influence of oxygene on the blood itſelf, there are terrible proofs of its importance in the ſyſtem, and how miſerable the perſon is who has imperfect organs or an ill oxygenated blood.

Nature, diſregarding all occaſional ſupplies, as by the abſorption of the ſkin, the aſſimilation of aliments, &c. has appointed one great organ for the oxygenation of the blood, viz. the lungs. In opening the breaſt of a living creature we beſt ſee the connection of reſpiration with the great ſyſtem; but it is out of the body that we can beſt underſtand its particular effects upon the BLOOD.

The moſt obvious effect of air is its heightening the colour of the blood. If we expoſe blood to fixed air, or azotic air, it continues dark; theſe fluids communicate nothing, they have no effect on the colour of the blood: when we expoſe blood to atmoſpheric air, it aſſumes a florid colour; for in the atmoſphere there is a large proportion of oxygene gas: if, laſtly, we expoſe it to oxygene gas, the pureſt of all air, it grows extremely florid; and whenever it changes its colour, it is by abſorbing oxygene, for it reduces in the ſame proportion the quantity of air; what it abſorbs is the oxygene or pure air, what it leaves is mephitis, unfit for combuſtion or animal life *.

Blood when expoſed to the air becomes red chiefly on the ſurface, it remains black beneath, but by turning up the clot to the air all the ſurfaces become red. If air be blown into a tied vein, the blood which was black in the vein becomes florid; and when the air is preſſed out again, it becomes black. If the air-pump be exhauſted over a diſh of blood, the blood becomes dark in the vacuum; and it becomes florid when the air is allowed to ruſh in again. If you expoſe blood in a moiſt bladder, the blood is oxygenated through the walls of the bladder; which brings this experiment as cloſe as may be to the phenomenon of blood oxygenated through the walls of the lungs. Though ſerum or milk be interpoſed, or urine, ſtill the blood is oxygenated, becauſe theſe are perfect animal fluids; but it is not oxygenated if oil, mucilage, or mere water, be interpoſed.

When we open a Frog, or Newt †, or other amphibious creature, we ſee a long and ſlender artery, accompanied by a ſlender vein, running from top to bottom along the whole ſurface of their lungs; and while their heart continues to beat, we ſee this pulmonic artery black, the vein red, the lungs themſelves moſt

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* Mr. Beddoes, in his laſt Book, makes hydrocarbon as effectual in reddening the blood as oxygen air. What are we to think of this? Is it a freak of nature, or of the author?

† See Chap. III.

delicate and pellucid, like the ſwimming bladder of a fiſh: Even in the extremities of the human ſyſtem the blood of a vein is dark, of an artery red; ſo that ſurgeons diſtinguiſh venous and arterial hæmorrhagies in this way.

From theſe facts we may underſtand why the blood of the womb, of ſinuſes, of varices, and of all ſtagnant veins, is ſo offenſive and black; and why that blood is ſo very pure and florid which is coughed up from the lungs. Is not the face livid in apoplexies or ſtrangulations, in hanging or drowning, in fits of paſſion or of coughing, or in any accident which interrupts the lungs? The face of a child during a paroxyſm of the hooping cough, is it not completely black? Is not the hand livid when the arm is compreſſed or tied up, and its blood prevented from returning to the lungs and heart? Are not tumours dark-coloured from dilated veins which return their blood too ſlowly? Are not thoſe mulberry marks which are born with us juſt ſmall aneuriſms full of ill oxygenated blood?—Then this firſt effect of oxygenation is a reddening of the blood. The menſtrual blood, the blood of ecchymoſis (as in thoſe who have been whipt), the blood of aneuriſmal bags, are all black; and the blood of varices is ſo very black, that the ancients ſaid they were filled with atrabilis or black bile. The ſtripes inflicted on a ſoldier as a puniſhment are at firſt of the moſt lively red, but ſoon become black.

The next effect of oxygenation is the endowing the blood with a peculiar ſtimulant power; by which it is continually operating upon the living ſolid: this is a power which it is continually loſing; which it is

every moment giving up to the ſolids; and which n
other proceſs but reſpiration can reſtore. This ſti
mulant power the blood gradually loſes as it circu
lates round the body; it is quite effete when it return
to the right ſide of the heart: the heart of a creatur
never moves, if we allow its lungs to lie collapſed
but the heart returns to act the very inſtant th
pure air is forced into the lungs, and ſo communic
ted to the blood. This ſtimulant power is moſt of a
apparent when we force a living creature to breath
nothing but the pureſt air; for oxygenated or vit
air makes this proceſs too rapid; the pulſe riſes, th
eyes become red and prominent, the creature ſeem
drunk with the new ſtimulus, too great for its ſy
ſtem. The univerſal heat of its body is greatly in
creaſed, the eyes are turgid and red, and at laſt
ſweat breaks forth all over it; and when dead, th
lungs (it is ſaid) are mortified or inflamed. Bu
whatever the marks are, whether theſe ſigns of in
flammation be really true, it is plain, ſince the crea
ture dies, that pure air is fatal by a too rapid oxy
genation of the blood. If, in our experiments upon
dying animal, we inflate the lungs with mephitic ai
the heart does not act; if we inflate its lungs wit
common air, the heart begins to act; if we inflate it
lungs with oxygene air, the heart is irritated to a ſti
more powerful action.

If we open the breaſt of a Frog and ſtop its breath
ing, we obſerve, firſt, its pulmonic blood florid, an
the heart beating ſtrongly: Secondly, in half an hou
the pulmonic blood has become dark, and the heart'
motion has grown languid; in a little while the pul
moni

monic blood becomes black, and the pulſation of the heart ceaſes: And, laſtly, the trachea of the Frog being untied, and the creature allowed to breathe again, the blood becomes florid, and the heart acts.

OF THE HEAT OF THE BLOOD.

The next effect of oxygene is ſaid to be the communicating of HEAT to the lungs. But I ſuſpect that if the ſmall quantity of oxygene which can enter by the lungs do communicate heat, it muſt be not to the lungs, nor to the blood, but to the whole body through the medium of the blood. There are ſome who pretend to ſay, that when they draw in vital air, they feel a genial warmth in the breaſt, diffuſing itſelf over all the body; but it is eaſy to feel in this way, or any way, when a favourite doctrine is at ſtake, while thoſe who know nothing about doctrines breathe the vital air without any peculiar feeling which they can explain.

There are many circumſtances which make it hard to believe that there is, in conſequence of the oxydation of the blood, any remarkable generation of heat in the lungs. Oxydation of the blood, out of the body, is attended with no increaſe of heat, and yet we operate on a quantity of blood much greater than that which circulates through the lungs. We call this proceſs not the oxygenation, but the oxydation of the blood, becauſe we are conſcious that it is an imperfect proceſs; it is perfect, indeed, with regard to its ultimate object, viz. that of communicating oxygene to the whole body; but as an aſſumption of the acidifying principle into the blood itſelf, we ſee it to be ſo imperfect, the union ſo ſlight betwixt the oxygene and the blood, that it parts each new edition of the book on animal heat muſt be prefaced with new apologies, new confeſſions, new corrections, new calculations, unhinging ſo entirely the concluſions and calculations of former copies of it, that we find ourſelves engaged, along with our inſtructor, in a wilderneſs of errors, from which we can have no hopes of being extricated.

Oxydation is a proceſs which had no place in Dr. Crawford's views; he never conceived that it was the preſence of oxygene, as a new principle, which gave colour, ſtimulant powers, coagulability, and all its moſt uſeful properties, to the blood; but he believed that pure air, uniting with inflammable air in the lungs, formed fixed air; and this fixed air being incapable of containing the heat which it had while in the ſtate of pure air, that heat was depoſited, or, as it were, precipitated upon the blood. He maintains, that there are of inflammable air two kinds; one capable of forming water, another of forming fixed air; but fixed air, derived from inflammable gas of any kind, all chemiſts will deny. He begins his doctrine, therefore, not with a fact, but with a petitio principii; and what is worſe, his main experiment is wrong. He was extremely anxious to prove, that in proportion as air was changed by reſpiration, it gave out its heat to the blood; he alſo wiſhed to put reſpiration and combuſtion on one level; and by this ſecond thought he forgot entirely what he firſt had it in mind to prove. Accordingly, having incloſed a Guinea-pig in pure air, and under water, he found that the air which it had reſpired communicated nearly the ſame heat to water that burning the ſame quantity of air would have done: by which he proved much more than he intended; for he proved plainly by this, that all the heat which reſpiration can poſſibly generate is by the fixed air carried from the lungs, and he forgot to reſerve any for going into the blood.

This ſlip of Dr. Crawford's leads us to perceive what becomes of any proportion of heat that may be generated in the lungs. In the firſt place, this reſpiration is not a rapid but a ſlow and gradual oxydation, for the quantity of pure air in the atmoſphere is ſmall. It is not a perfect oxydation, the blood bearing no marks of an acid, nor its oxydation cauſing any heat. It is not a fair nor permanent oxydation; for blood ſoon loſes its colour out of the body, and within the body it returns very quickly from the extremities of the circulating ſyſtem into the heart, deprived of all its oxygene. The oxygene ſeems but ſlightly attached to the blood; it is not ſo much united with the blood as conveyed by it; and perhaps it is only when this principle is taken from the blood, and aſſimilated with the ſeveral parts of the body, and fixed among its ſolids, that it gives out heat. This proceſs of oxydation is intended rather for conveying new properties to the blood than for generating heat, and its chemical changes happen not ſo much in the lungs as in the extremities of the body.

But allowing it to be a perfect combination, a full oxygenation of the blood, and that this, like every other oxygenation, muſt give out heat exactly proportioned to the quantity of ſpoiled air, it is eaſy to perceive how this heat may be beſtowed; for in reſpiration there is always a generation of fixed air; there is much water formed and diſcharged in halitus from the lungs; the heat, whatever is evolved, muſt be divided into three proportions: Firſt, when a part of the oxygene attaches itſelf to the blood, heat will be evolved, which might be ſuppoſed to enter the blood: But, ſecondly, there is formed in the ſame moment a quantity of fixed air, which ariſes from a ſecond portion of the oxygene uniting with the carbon of the blood; and this fixed air requires ſome proportion of the heat to keep it in its aërial form. Thirdly, a third portion of the oxygene unites itſelf with the hydrogene or inflammable air, and generates water; this water exhales in ſteam or halitus from the lungs: and how great a proportion of heat neceſſary to preſerve water in the form of ſteam, is known to every tyro. Now, to prove that all the heat is expended, not upon the blood, but upon the halitus, or upon the fixed air, we have only to retort their own grand experiment upon the believers in this doctrine, viz. that the breath of an animal communicates the ſame proportion of heat to water that combuſtion does; of courſe none is left to paſs into the blood. Theſe philoſophers do not mean to ſay that reſpiration is as rapid as combuſtion, or gives out the ſame quantity of heat in the ſame ſpaces; there is not even any two combuſtions, *i. e.* any two inflammable bodies, which are in this reſpect alike: they mean, no doubt, to acknowledge the one to be ſlow and the other rapid; they mean only that the ſame quantities of air being uſed in each proceſs, the ſame quantities of heat will be produced; that one hundred ounces of air being burnt by a taper, and the ſame quantity of air exhauſted by the breathing of any animal, the water which ſurrounds the air, in either caſe, will be raiſed to the ſame temperature, or, if ſurrounded with ice, the ſame quantities of ice will be diſſolved. But to tell us this, is to tell us nothing; for without knowing the rapidity of the proceſs, we know nothing of the intenſity of the heat. Suppoſe, for example, that one of theſe philoſophers had told us that iron-filings put into water to ruſt acquire the ſame quantity of oxygene that iron burnt in the fire does, and, though ſlowly, gives out the ſame quantity of heat, becauſe it can acquire no oxygene but what parts with its heat. All this is true; but yet burning and ruſting are very different, and ſo combuſtion and reſpiration are. While the vapour which iſſues from the lungs keeps to the temperature of 96°, and while the lungs and heart do not exceed in heat the reſt of the body, there can be little chance of any heat being generated in the lungs, except what is balanced and carried of by the hydrogene and carbonic airs, or by the halitus from the natural ſecretions of the lungs.

That the animal heat is produced by the action of veſſels; that heat does not proceed from the lungs, but is produced in each part of the body—is beautifully proved by what happens in aneuriſm, where the artery is tied up (in the thigh for example); and where we make, as it were, a great experiment upon animal heat, in the human body itſelf.

1ſt, Immediately after the operation, the pulſe is ſtopped, the limb is benumbed, it grows cold, and ſinks one or two degrees below the ſtandard of its natural heat. This is the moment of total interruption in the great trunk, and of particular danger. 2dly, In a little while the limb begins to grow warm; it ſwells, and gradually the limb, from being warm only, becomes hot, and the heat riſes many degrees above the ſtandard heat of the limb, and above the general heat of the reſt of that ſyſtem to which it belongs. In this ſecond ſtage there is ſtill no pulſe; which proves that the circulation in the great artery is not reſtored; the heat, ſwelling, and ſlight inflammation which poſſeſſes the whole limb, plainly proceed from the univerſal action of all the ſmaller arteries, for the blood has not yet found out any one artery capable of a. ✓ diluting ſo far as to carry on the circulation eaſily, and reſtore the pulſe. 3d, But in the next period the pulſe begins to creep; at laſt it is plainly felt; then it waxes ſtronger from day to day, till in proceſs of time it beats as vigorouſly as in the ſound limb. Now the blood has forced and dilated ſome greater artery, the blood flows through the limb, as formerly, in one main channel. The ſmaller arteries are freed from their load, and ceaſe from their exceſſive action, and, in exact proportion as the pulſe returns, the unnatural heat ſubſides gradually, till at laſt it is reduced to the common heat of the body. Thus we may perceive very clearly, that it is while the communication with the ſyſtem (and with the lungs of courſe) by the blood-veſſels is the moſt difficult that the heat riſes; that when the free communication is reſtored, it falls; that the intermediate period, in which there is plainly, from the redneſs and ſwelling of the limb, an exceſs of action in all its ſmaller arteries, is the period of exceſſive heat; and indeed we may obſerve, though in a leſs ſtriking way, the ſame phenomenon in every inflammation, or, in other terms, in every local diſeaſe, viz. the temperature changed, without any apparent dependence on that of the ſyſtem at large. We perceive in the cleareſt manner that heat is continually formed in all the extremities of the ſyſtem; and when we think of the proceſſes which are continually going on in various parts, we cannot but believe that oxygene is completely aſſimilated, and gives out its heat, not when it is received into the blood, with which it ſeems ſo ſlightly united, but when it is diſtributed through the body, and aſſimilated with its parts, of which it forms ſo important a principle. In the human body various acids are produced; the phoſphoric acid; the lithic acid, or that which is excreted by the urine; the acidum pingue, or acid of fat, for fat is a proper oxyd from which this animal acid can be eaſily obtained. In Ants and other animals peculiar acids are formed: theſe certainly are direct proofs that the oxygene is depoſited from the blood.

But in reflecting upon this moſt difficult of all ſubjects, the generation of heat in the living body, many things are to be taken into the calculation, which ſeem, on the ſlighteſt glance, to be far more important than this depoſition of oxygene from the blood. It is a law of nature, to which, as far as we know, no exception is found, that a body, while it paſſes from an aërial to a fluid form, or from a fluid to a ſolid form, gives out heat. Now, what is the whole buſineſs of the living ſyſtem but a continual aſſimilation of new parts, making them continually paſs from a fluid into a ſolid form? The whole nouriſhment of the body goes on in the extreme veſſels, and is a continual aſſumption of new parts. The extreme veſſels are continually employed in forming ſome acids, which appear naked in the ſecretions; in forming oxyds, as the fat and the jellies of the membranous and white parts; in the various depoſitions of muſcle, bone, tendon, &c. for theſe are all continually abſorbed, thrown off by the urine and inceſſantly renewed. They are continually employed in filling all the interſtices of the body with a bland fluid or halitus; they are continually employed in forming ſecretions of various kinds. In performing all this the power of the veſſels may do much; but the ultimate effect in each proceſs muſt be a chemical change, and perpetual changes will produce a conſtant heat. Place the organ and focus of this animal heat in the centre of the body, and you are embarraſſed in a thouſand difficulties; allow this heat to ariſe in each part according to its degree of action, and each part provides for itſelf.

But how then, ſome will ſay, ſhall this heat be regulated? I ſay plainly by the heart and lungs. The lungs regulate the ſtimulant power of the blood, the heart regulates the action of the arteries, in ſo far as regards the ſtimulus of fulneſs and diſtention; and with theſe to regulate the centre, nothing can alter the heat of the extremities except partial actions, that is, diſeaſe.

I will conclude then, that oxygene, if it do communicate heat, does ſo, " not to the lungs nor to the blood, but to the whole body through the medium of the blood."

OF THE RESPIRATION OF ANIMALS.

The effects of oxydation then are, to redden the blood, to renew its ſtimulant power, and to communicate heat, not ſo much to the blood as to the whole body through the medium of the blood, and to aſſiſt in the ſecretions and chemical changes which are inceſſantly going on in all parts of the ſyſtem. This is accompliſhed by the perpetual and rapid motion of the blood through the lungs; and there it is expoſed to our atmoſphere, which is a mixed fluid very different from what we at firſt conceive, or what our ignorant wiſhes might deſire to have it; not conſiſting merely of air fit to be breathed, but for the greateſt part formed of an air which is moſt fatal to animal life, whence it has the name of Azotic Gas. Of an hundred meaſures of atmoſpheric air, we find twenty-ſeven only to conſiſt of vital or pure air; ſeventy-two conſiſt of azotic air as it is called, fatal to animal life; and one meaſure only is fixed air, which is alſo an unreſpirable air. But of theſe twenty-ſeven parts of pure air, ſeventeen parts only are affected by reſpiration; ſo that in reſpiration we uſe much leſs than a fifth part, even of the ſmall quantity of air which we take in at each breath.

The change of the air by reſpiration is this chiefly; that the quantity is diminiſhed by the abſtraction of a part of the vital air; that there is formed a quantity of fixed air, which is generated in the lungs; and that there is diſcharged along with theſe a quantity of watery halitus. Therefore atmoſpheric air, after it has been breathed, is found to have ſuffered theſe changes: Firſt, It contains now a conſiderable proportion of fixed air, which is eaſily diſcovered, and even weighed; becauſe when a cauſtic alkali is expoſed to it, the alkali abſorbs the fixed air and becomes mild. Secondly, It has leſs of the vital air, as is eaſily aſcertained by the eudiometer which meaſures the purity of the whole: And, thirdly, All that remains is merely azotic air, unfit for animal life, or for ſupporting flame. The oxygene, then, in part unites itſelf with the blood; in part it forms fixed air by combining with the carbon of the lungs, in part it forms water by combining with the hydrogene of the blood. Reſpiration frees the blood of two noxious principles, the hydrogene and carbon, the charcoal and the inflammable air: and it inſinuates a new principle, viz. the oxygene, into the blood.

Nature has appointed but a ſmall proportion of vital air for our uſe; our atmoſphere is ſo conſtituted as to hold but a fourth part of vital air, and of that ſmall proportion one half only is uſed in the lungs. We ſee by this how neceſſary this contamination of our atmoſphere is, which ſeems ſo unfavourable to life: nature intended that we ſhould breathe ſlowly a modified atmoſphere! With nothing but the pureſt air to breathe, our life would be quickly conſumed, like that deflagration of iron, which is ſo rapid in vital air, while it burns ſo moderately and ſlowly in the common air.

Theſe aſſiſtances which we have from chemiſtry are but a promiſe of what that ſcience may do; nothing of all that we know concerning the chemiſtry of the blood is either perfect or ſure: we have our expectations ſtill of ſeeing things more completely explained; but our expectations are not like thoſe of Mr. Moiſes, who, in a certain diſſertation on the blood, ſeems ſo full of his new leſſons in chemiſtry, and ſo confident of his future atchievements in that ſcience, as to expect that muſcular motion ſhall be very thoroughly explained, and that it will be found to be nothing elſe, in all the world, but "an exploſion of hydrogene and oxygene," and God knows what!—but it is after the manner of "a ſteam-engine;" and if his ſcheme holds, they are to be fired off "by means of the nervous electricity of Galvani *!"

OF THE RESPIRATION OF PLANTS.

But after this view of animal reſpiration, it is not eaſy to refrain from ſaying a few words on the reſpiration of plants, which bears a relation to animals of infinite importance, and indeed to all nature.

Water has all the appearance of a pure and ſimple element, but it is in truth a compound body, conſiſting of two parts; of inflammable air for its baſis, and of oxygene combined with it, in that great proportion which the great appetite of inflammable air requires: and as inflammable air, when ſaturated with oxygene, forms not any acid air, but pure water, it has changed its name, and is now called hydrogene air. When we make water paſs through a bed of charcoal, heated to a great degree, the oxygene is ſeized by the carbon and converted into fixed

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* Vide page 236.

air; while the hydrogene of the water is collected in its proper form of inflammable air. When we make water fall drop by drop into a gun-barrel, heated to a high degree, we find that the oxygene calcines the gun-barrel, the inflammable air is collected in the pneumatic apparatus; and the oxygene which has calcined the iron, and the inflammable air which is received in the glaſs veſſels, exactly account for the quantity of water which has been analyſed.

Nay, we can carry this proceſs much farther than many of the other delicate proceſſes in chemiſtry; we can re-compoſe this water. If we mix in a jar inflammable and pure air, and fire the electric ſpark through them, water is inſtantly formed, weighing exactly the quantity of both the airs *. Thus, both by ſyntheſis and analyſis, we prove that water is compoſed of pure and of inflammable air; we find (what it ſeems difficult to believe, though it was foretold by the great Newton) that water contains an inflammable body; we find, to our great aſtoniſhment, while we are regarding the atmoſphere which ſurrounds us as the great magazine of air, that water, where its preſence never was ſuſpected, contains an infinitely greater quantity of vital air than the atmoſphere; that our atmoſphere contains $\frac{27}{100}$ parts only, while water contains $\frac{85}{100}$ of pure air.

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* These beautiful experiments were firſt made in England by Prieſtley, Warletire, and Cavendiſh (vide Philoſophical Tranſactions, anno 1784); and when Lavoiſier was firſt told of water being formed by exploding inflammable air, he ſaid it was a thing which he could not believe.

We find this decompoſition of water offering new connections, and great views of nature, in all the departments of vegetable and animal life; which, in this place at leaſt, we dare not purſue. How perfectly ſimple the ſtructure of the moſt delicate plants and flowers are, may be eaſily ſeen in the regularity of thoſe veſſels which run through them in one curve or ſlightly ſpiral line from root to flower. This ſimplicity of ſtructure muſt be preſumed from a thouſand facts in gardening, very ordinary but very ſurpriſing: Parts may be cut from one plant and engrafted on another; ſlips ſhoot and thrive, and grafts may be inſerted with either end downwards; if with the upper part downwards, ſtill it thrives; the upper part then ſends roots into the earth, while that which ſhould have been the root puts forth leaves. It is ſtill a more curious proof of the ſimple organization of plants, that all the parts of plants, their roots, ſtalks, leaves, fruit, are all capable of performing the common functions apart: the branches or leaves of plants, if plunged in ſoil, pump up their ſap as uſual; even the leaves, ſtrewed upon the ſurface of water, abſorb the water; and if it be impregnated, for example, with fixed air, they abſorb the air, decompoſe it, reſerve the carbon, and treaſure it up in their own ſubſtance, and emit nothing but the pureſt air.

Many things I muſt here paſs over in ſilence; as, how plants perform their functions, and aſſimilate the principles of colour, taſte, and ſmell, only when ſtimulated and aided by the preſence of heat and light; how, when they abſorb the atmoſphere along with their other food, they uſe chiefly the carbonic or mephitic airs, and breathe out the pure air again, or reſerve only ſmaller proportions, in order to form their ſweets, and modify their various acids, and fit them for fermentation, by which all their moſt valuable products are evolved. Nor dare I ſtay to relate the curious harmony betwixt the airs which they thus abſorb, and the aërial acids, ſpirits, and other products, which fermentation diſplays.

I have mentioned the ſimplicity of their organization, only that I might obſerve once more how perfectly they are nouriſhed by water alone, and how their ſimple organization converts this apparently ſimple element into their own ſubſtance. For water being abſorbed by any plant is decompoſed thus: The inflammable air is aſſumed into the plant, and becomes a part of its ſubſtance *: The oxygene is in quantity infinitely too great to be altogether digeſted or uſed; the oxygene or vital air therefore exhales from plants in a continual ſtream; all that air which would poiſon animals is uſed by plants, and all the air which animals contaminate plants renew. The freſhneſs of the country, the delights of ſpring, and all that infuſion of health and ſpirits which we feel in a morning's walk, are now no myſtery to us; for at that hour the plants are by the ſun and moiſture rouſed from their ſleep, and this proceſs is begun. Perhaps there is not in all nature a more beautiful

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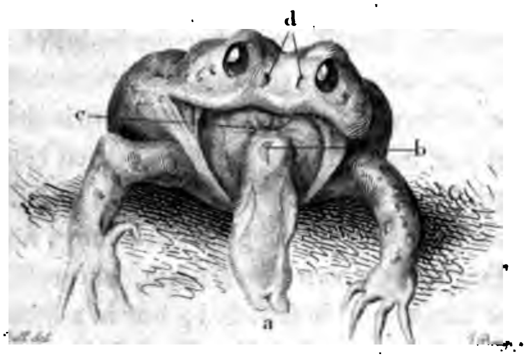
* Fiſhes, many of them live entirely on water; and water alone ſuſtains the human body for many weeks under fevers, &c.

harmony than this, that the foul breath of animals gives life to plants, while the air reſpired by plants is uſeful to animals and delightful to man.



CHAP. III.

OF RESPIRATION,

OR THE MANNER IN WHICH THE OXYDATION OF THE BLOOD IS ACCOMPLISHED IN VARIOUS ANIMALS AND IN MAN.

THOSE who are the beſt acquainted with the comparative anatomy, will beſt know how natural it is for me to illuſtrate this function, by comparing various animals with man; how pleaſant, how uſeful, it is to know theſe analogies, every ſtudent muſt feel: and it is now full time to correct many miſtakes into which modern as well as ancient authors have wandered, from want of general principles, and from want of anatomical knowledge. I ſhall endeavour to make this chapter intereſting and ſhort.

At one time all authors believed that the lungs were moved, not by any external agent, but by ſome internal power reſiding in the lungs.

When in their firſt eſſays to inveſtigate this ſubject they opened the thorax, or rather the body, of amphibious animals, they obſerved that the creature lay out upon the table with expanded lungs; that the lungs continued for hours to appear like inflated bladders; the lungs expanded, the heart playing, the creature quite alive. When they emptied their lungs for them by thruſting tubes down the trachea, or preſſing the lungs, the lungs entirely ſubſided; but in a little while the lungs, at the creature's will, roſe again into complete inflation; again they appeared like two tenſe bladders. Surely, ſaid they, there reſides ſome expanſile power in the lungs themſelves? But when a few of them began to purſue this miſtake with ſerious experiments, they committed abſurdities which ſhould be noticed, for they ſerve to illuſtrate the true doctrine concerning the expanſion of the lungs.

Mr. Houſton, in our Philoſophical Tranſactions, undertook to prove the following things, which, to uſ the words of a learned author in our univerſity, "ar ſo improbable as to be incredible;" firſt, That th breathing of a Dog is nothing affected by any wou of the thorax, if only the lungs themſelves be n hurt; ſecondly, That the lungs never collapſe, thou the thorax be laid open; thirdly, That when the breaſt is entirely laid open, the lungs continue to move, and the thorax alſo continues to move, but that the motion of the thorax never keeps time with the motions of the lungs.' But, to do Houſton juſtice, he endeavoured to explain away the inconſiſtencies of his own experiments; and the world would never have been troubled any more with them, had it not been for a Mr. Bremond, a great academician, philoſopher, and experiment-maker, who publiſhed the following ſuite of experiments in the academy of Paris.

His firſt miſtake is this. "I found (ſays he) that having ſtabbed a Dog in one ſide only, it could run about the houſe and howl." This is what nobody will doubt. "But alſo (ſays he) the air which the Dog took in by the wound when it expired, was preſſed out again by the wound when it inſpired." This is one cunning ſtroke of Mr. Bremond; for had the air entered the cheſt during inſpiration, that muſt have proceeded from the riſing of the thorax, which is not the kind of reſpiration which he wanted to prove: But as the air entered the cheſt during expiration, it proceeds clearly, according to his principles, that the lungs in ſqueezing out their air have a contractile power; that they contract by their own motion, and leave the ribs, and ſo make room for the air.

"Next (ſays Mr. Bremond,) I opened the thorax of a living Dog, and there I ſaw, that when the lungs contracted the thorax dilated, and when the thorax contracted the lungs dilated."—But, in fact, it means no more than this, that often in theſe agonies produced by ſuch cruel experiments upon animals, or by actual wounds in the human body, the diaphragm, cheſt, every thing which contributes to breathing, is ſo cloſely contracted, and the preſſure is ſo great, that the lungs are actually compreſſed and protruded: ſo that his ſeeing, as he ſays, the lungs dilated, that is, ſqueezed out, when the thorax contracted, is like the ignorance of a child looking from a carriage-window, who believes and wonders at the trees and houſes running backwards. But as no experiment-maker ever allows his experiments to remain incomplete, Mr. Bremond finiſhes his by the following daring aſſertion, "that always when he made his inciſion no more than three inches long, the lungs dilated themſelves with ſo much violence that they drove out the air before them, protruded themſelves through the opening, and made the blood jerk out at all points *." In ſhort, he repeats this miſtake in every poſſible form, viz. that the motions of the lungs and thorax are directly oppoſite to each other; that the lungs are contracting while the thorax dilates, and the thorax contracting again when the lungs dilate. When I open a Frog, it fills its lungs with perfect eaſe after both its breaſt and belly have been entirely cut away. "If admitting air into the thorax could really make the lungs collapſe, why do not thoſe of the Frog collapſe?" This is ſuch groſs ignorance as ſhould not have been endured in one reading papers before the

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* If one word of this were true, what would become of thoſe who had adheſions of the lungs? Surely if the lungs and thorax moved in oppoſite directions, the one contracting while the other dilated, the force of the lungs never could pull down the thorax.—Such patients muſt die.

Roy

Royal Academy of France. He is farther back in phyſiology than Oligerius, Jacobæus, or Malpighi.—The Frog has a reſpiration peculiar to itſelf, or at leaſt to its kind.

FIRST SPECIES OF RESPIRATION, VIZ. BY A DIAPHRAGM.

Under this title I ſhall explain the reſpiration of Man, and of animals like Man; which have heavy lungs, of a ſtrong fleſhy texture, a prodigious number of blood-veſſels paſſing through them, their lungs lodged entirely in the cheſt, and their reſpiration performed by a diaphragm.—I mean to arrange reſpiration according to the mechaniſm of thoſe organs by which it is performed; and place in the firſt order that of Man, and animals which in this point reſemble Man; and I ſay reſpiration by a diaphragm, for this is indeed the only uſe of a diaphragm. The ſupport of the great blood veſſels, the compreſſion of the viſcera, the expulſion of the urine and fœces, the ridding the womb of its burden; all could have been performed by the preſſure of the abdominal muſcles alone! the diaphragm is added merely for breathing.

Forſaking, for a moment, authority and minute anatomy, let us explain it in the ſhorteſt and moſt intelligible way.—The diaphragm divides the thorax from the abdomen; it is ſtrong, muſcular, and acts with great power, enlarging the thorax; it is convex towards the breaſt, and concave towards the belly: when it acts, the belly is protruded, the diaphragm becomes flat, the thorax is enlarged, and a vacuum would be formed; but that inſtantly the lungs follow it and prevent a vacuum; for the lungs are free in the thorax, the air has free acceſs to go down into the veſicles of the lungs; and ſo when the diaphragm retires, the lungs follow it, being dilated by the preſſure of the air which enters by the trachea.

But this protruſion of the belly excites the abdominal muſcles to react; their preſſure reſtores the diaphragm to its natural form; when preſſed back again by the abdominal viſcera, it riſes in the thorax, becomes again convex towards the lungs, the thorax is reduced in ſize, the lungs are compreſſed, and that air is driven out again which they had juſt received. The thorax alſo moves in concert with the diaphragm: and this motion is moſt curiouſly arranged; for, firſt, the intercoſtal muſcles lift the thorax for reſpiration, in the very moment in which the diaphragm is preſſing down, and conſequently at the inſtant when the abdominal muſcles, which are attached to the lower borders of the thorax, are relaxed, ſo that they ſuffer it to riſe. Next, the thorax is to be compreſſed and pulled down by the abdominal muſcles; and this happens at the very inſtant in which the abdominal muſcles react againſt the diaphragm; ſo that the abdominal muſcles, while they thruſt back the diaphragm, pull the lower edges of the thorax down with great power.

Thus in Man, and almoſt all animals, the reſpiration is performed by a diaphragm.

SECOND SPECIES OF RESPIRATION, VIZ. THAT OF BIRDS.

BIRDS are ſuppoſed to breathe like Man, but have in fact no diaphragm to divide their body; they have veſicles, or air bags extending through the whole body, and connected with the true lungs; their ſternum and ribs expand over the whole, and by their motion move the air veſicles, which blow the air through the true lungs; while the true lungs, far from having any thing to do with a diaphragm, never move.

Every one ſkilled either in anatomy or phyſiology muſt know, that one of the greateſt phyſiologiſts of our times has written a long paper about the reſpiration of birds, little underſtood, and in proportion much admired; of which function he is ſo thoroughly ignorant, as to explain how they breathe with a diaphragm: and until I ſet this point right, my arrangement is good for nothing.

"The diaphragm of fowls (ſays Mr. Hunter,) is thin, tranſparent, and membranous, aud runs acroſs the abdomen." But if thin, membranous, and tranſparent, it can perform none of the functions of a diaphragm, and muſt be merely ſuch a membranous interſeptum as ſome Amphibiæ and Reptiles have, ſupporting the viſcera, or confining them in their place. But he thinks to make good his point by acknowledging the imperfection of this diaphragm; and adding, that it is moved by certain ſmall muſcles, which ariſe from the inner ſurface of the ribs, and pull the diaphragm and lungs down. He ſtill perſiſts in calling it a diaphragm, in the very ſentence in which he informs us that "it is perforated in many places with holes of a conſiderable ſize." Since Mr. Hunter is ſo bold as to ſay of other authors, that they have too limited notions of a diaphragm, we may be allowed to ſay, that his notions of it are as much too liberal as theirs are too confined. But deſcriptions and arguments of this kind, where the author is entirely wrong, ſhould not be tediouſly refuted, nor anſwered in any other way than by a ſimple ſtatement of the caſe *.

The anatomy of a fowl's reſpiratory organs is plainly this.—The trachea having deſcended into the thorax, divides into two branches; of which one goes in a ſimple and ordinary manner into each ſide of the lungs. The heart, which lies immediately upon this diviſion of the trachea, ſends into the lungs two great pulmonic arteries, and receives in return two veins. The lungs themſelves are very ſmall, denſe, and bloody; they are ſomewhat of the ſhape

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* For the reſpiration of birds, *i. e.* for raiſing and depreſſing the thorax, I ſee many muſcles having a very ſtrong analogy with thoſe of Man. The pectoral muſcles are amazingly ſtrong, and their ſcapulas abſolutely fixed, ſo that theſe could raiſe the breaſt with great power; but I ſuſpect that no ſuch power is needed, that the elaſticity merely of the ſternum and ribs raiſes them. There lies under theſe, upon the back, a very ſtrong muſcle like our ſerratus poſticus. There lies on the inſide of the ribs a ſet of three beautiful muſcles like large intercoſtals; they are quite inſulated from all other parts, are ſeen inſtantly upon opening the belly: theſe are what Mr. Hunter calls Muſcles of the Diaphragm; but in truth the breaſt of a bird is pulled down ſtrongly by its ſhort yet ſtrong abdominal muſcles, and riſes again by its own elaſticity with little help; and theſe are merely intercoſtal muſcles,

of the human lungs; they are ſeated in the very uppermoſt part of the cheſt, are cloſely braced down to the back, and are indeed in part niched in among the ribs, which in birds have their edges very deep. Theſe are the true lungs for oxydating the blood; they never move; the air paſſes through them in the following way.

Theſe lungs cannot move, becauſe they are braced down by a membrane very thin, and cobweb-like, yet very ſtrong. This membrane is a peritoneum, lining at once the whole thorax and abdomen (which ſtill are not parted from each other), and it is a covering to the lungs, liver, and other viſcera; but alſo the ſame cobweb-like membrane forms cells, which fill the whole cavity from the neck down to the anus, and from the breaſt-bone to the back; and which are ſo attached to all the ſurfaces, being, as I have ſaid, the lining membrane, that as the breaſt moves theſe cells muſt move.

Theſe cells appear at firſt ſight quite irregular; and Mr. Hunter gives but an idle deſcription of them along with that of the ſeptum, which he calls the diaphragm: But I hold it as a principle, that, although we may not ſee it, yet all is orderly in the animal body; in fact the order of theſe cells is extremely regular: Firſt, there is a membrane which comes down from the breaſt-bone in a perpendicular direction till it touches the viſcera; it runs the whole length of this common cavity of breaſt and abdomen; it enters into the great cleft of the liver, and ſo divides the liver into two lobes, ſerving as a ligament for the liver, as a mediaſtinum to divide the great cavity into two, and alſo as a ſort of roof or baſis for the cells of either ſide; though beautifully tranſparent, it is very ſtrong. At the upper end this mediaſtinum touches the heart, and there expands into a very large bag exquiſitely tranſparent, which is at once an air-cell and a large pericardium. Next, at its lower end, it touches the gizzard or ſtomach, and forms a large cell ſurrounding it. Behind the liver, which fills all the upper part of this great cavity, and the gizzard which fills all the lower part, lie all the inteſtines, which are alſo ſurrounded with many cells: at the ſides the cavity is occupied by three or four large cells extending from the middle membrane to the flanks of the bird. And, laſtly, when we look into thoſe greater cells which are neareſt the lungs, we ſee clearly many openings, very large, oblique, running flat under that part of the membrane which braces down the lungs, ſo as to communicate the air from the lungs to all the cells very freely.

Now let me add, in one word, that the eſſential parts of reſpiration are theſe: Firſt, There is no diaphragm, no diviſion of breaſt and belly, the ſtomach lying upon the rectum in the pelvis; a true and muſcular diaphragm could not exiſt in birds, having nothing to do in their ſcheme of reſpiration. Secondly, The true lungs are ſmall, high in the back, quite immoveable, ſo that no diaphragm nor no power of vacuum could unfold them; and theſe lungs are perforated at every point, ſo that they could not expand by air. Thirdly, What has been confounded with the true lungs is the vaſt congeries of abdominal cells, which are of uſe only in lightening the creature that it may fly, and in forcing the air through the true lungs. Fourthly, There is in the place of a divided abdomen and thorax, with long abdominal muſcles, no proper abdomen, a long thorax, a high ſternum, and very elaſtic ribs, extending along the whole body till they almoſt meet the pelvis, making the abdominal muſcles very ſhort; and the air-cells all along adhere to the inner ſurface of theſe bones.

With theſe points clearly before us, we cannot miſtake the mode of reſpiration in birds. The thorax does the whole; the thorax is raiſed, and immediately the cells are expanded, by which two functions are performed; for the air which comes into the cells, paſſing through the lungs, oxydates the blood, and the cells become full at the ſame time ſo as to make the body lighter. The thorax is depreſſed again, and the air, which paſſes now a ſecond time through the lungs, may a ſecond time oxydate the blood, for it is not thoroughly ſpoiled; and what is ſpoiled is diluted with the air of many cells, which reſpiration cannot empty at one ſtroke.

The final cauſe alſo is plain: Had the lungs in a fowl been ſolid and fleſhy as they are in fowls, (or even in any other creature,) and at the ſame time ſufficiently large to perform, without the help of thoſe air-bags, all the functions of lungs, they muſt have been large and heavy in proportion to the body of the fowl; they muſt have occupied much room, and added much to the weight. But the lungs of a fowl are very denſe, very ſmall in proportion to its ſyſtem, very full of blood, quite fixed, and undilatable; the rapid courſe of the air through them backwards and forwards enabling them in their buſineſs of oxygenation to do much with little. In ſhort, there are two functions to be performed in birds: Firſt, the oxydation of the blood, which is performed by the ſmall, fleſhy, contracted lungs, which lie immoveable in the upper part of the thorax, and through which the air blows continually as through a furnace, while they are quite paſſive: and, ſecondly, The lightening of their bodies for flying [*], which is performed by the abdominal cells; and the confounding of the abdominal cells with the true lungs, and the deſcribing of a diaphragm where none can be, was like to have put us all wrong [†].

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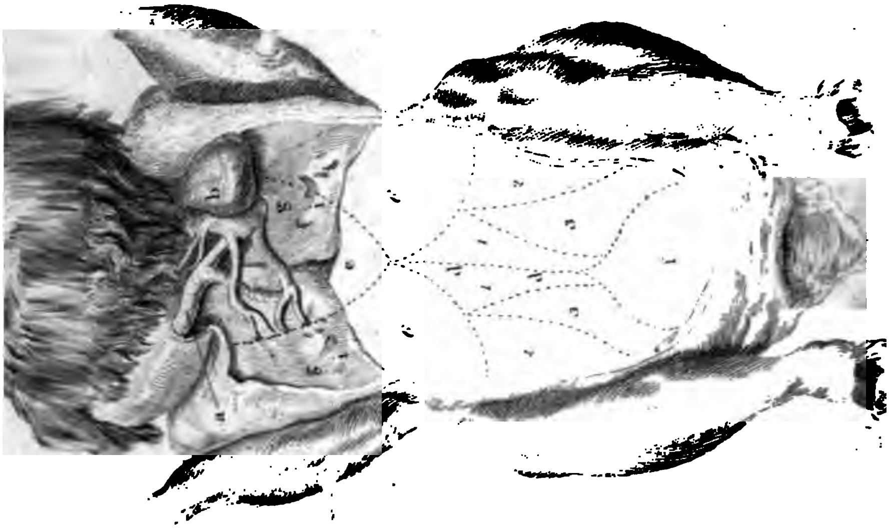
[*] Although I ſay the lightening of the bird for flying, I do not mean to affirm abſolutely, that it is either for flying that they are made light; for I have given, on the contrary, an example in a bird which ſeldom flies, viz. the common fowl; and I have added a plan of the Oſtrich's cells, which is a ſwift-footed bird, and never flies: nor do I even affirm, that it is for the ſake of lightneſs that theſe cells are thus provided. Perhaps one chief uſe is blowing through the true lungs to oxygenate the blood; yet I ſhould think lightneſs were a chief uſe, for the cells are far too large for this office alone of ventilating the lungs; and they are ſo diffuſed as to enter even into the bones of fowls, where the air is ſo freely admitted, that if you break a bone which has ſuch an air-cell in it, for example the ſhoulder-bone of a fowl, you produce an emphyſema.

[†] PLANS of the RESPIRATION of BIRDS.

In the firſt Plan is ſeen — (*a*) The trachea dividing into branches — (*b*) The heart ſending great pulmonic arteries to the lungs — (*c c*) The true lungs ſhaped like the human, but exceedingly ſmall, denſe, and bloody — (*d*) The thin and delicate membrane, which forms a mediaſtinum — (*e*) The great air-cell, in which the heart lay — (*f*) The cell where the ſtomach lay — (1, 2, 3, 4, 5) A number of cells, very large, which ſurround all the viſcera, and fill the whole abdomen — (6, 6,) Two large cells which lie neareſt the true lungs — (*g g*) The true lungs, which lie cloſe to the back-bone. — At (*i i*) is ſeen on each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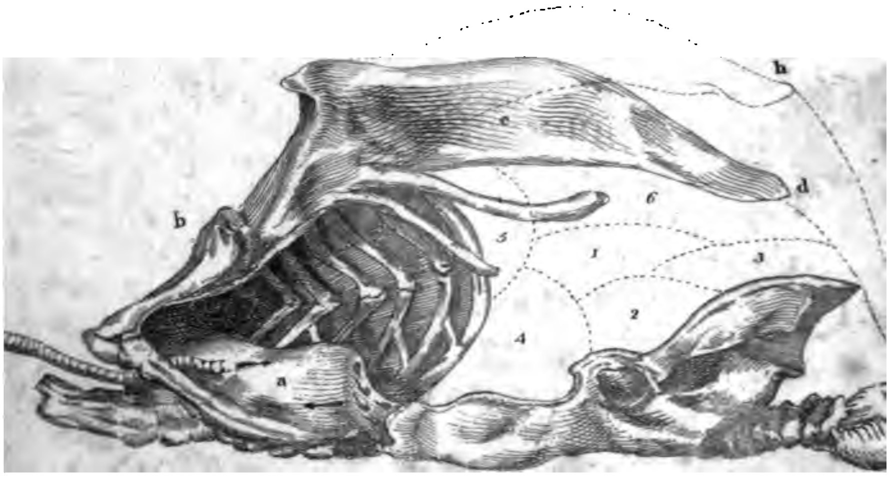
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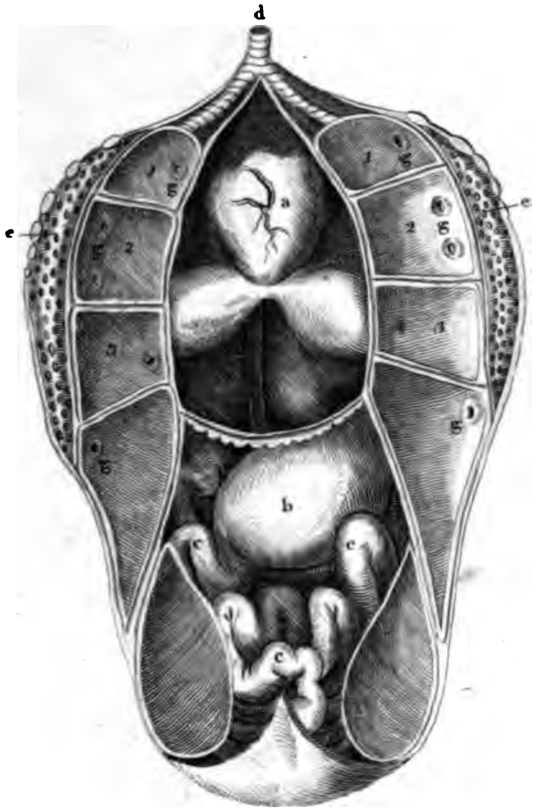
The Ostrich's Lungs
drawn by the Parisian dissectors



a The Heart lodged in one great Air Cell b the Stomach and c the Intestines surrounded by other great Cells. d the trachea branching towards the lungs. e e The true lungs firm fleshy very small & fixed down to the backbone. 1 2 3 other great Air Cells in immediate contact with the Lungs & communicating with all the other Cells. the holes g g g &c are the openings by wh the Cells communicate with the Lungs & with one another.

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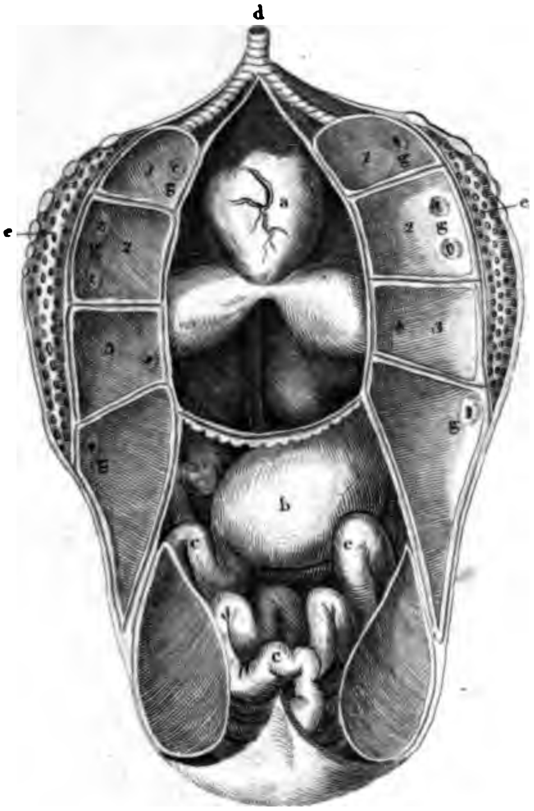

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THIRD SPECIES OF RESPIRATION, VIZ. THAT OF AMPHIBIA.

THIS ſpecies of reſpiration differs from the two firſt in theſe reſpects; it differs from the reſpiration of Man, becauſe there is no diaphragm; it differs from that of birds, for there is no cheſt covering the lungs: There is a ſhort ſternum, no cheſt, no ribs by which the lungs may be moved, there is no vacuum formed in their reſpiration; they fill the lungs by the working of their jaws, or, in other words, they ſwallow their air juſt as we ſwallow our food.

The Frog, the Newt, the Chamelion, the Tortoiſe, and many other creatures, breathe in this way; and as one of the moſt curious mechaniſms for reſpiration, I ſhall repreſent that of the Frog. I have placed at the beginning and end of this chapter two drawings, in which their organs of reſpiration are ſeen; for, as I have juſt explained, their organs of reſpiration are not in the belly, nor in the lungs themſelves, but in

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each ſide one of the many holes by which the true lungs give out their air to the abdominal veſicles. Figure 2d ſhows the manner of their reſpiration; for the air-veſicles are ſeen again (1, 2, 3,)—filling the whole abdomen. The true lungs are ſeen at (*a*)—lying cloſe by the ſpine, and as high as the root of the neck; and the length of the ſternum and ribs, which are marked (*b*, *c*, *d*, &c.)—ſhow that the fowl is all cheſt, and that every time the cheſt riſes to the line (*hhb*)—the veſicles are dilated, and the air paſſes through the lungs in the direction (*i*)—and every time the breaſt is pulled down by the abdominal muſcles, which are marked (*k*)—the air is driven out again through the lungs in the direction (*m*),—the lungs being all the while motionleſs, and paſſive merely.

the mouth. At (*a*) is ſeen its tongue of prodigious length; it is not like the tongue of any other creature, hinged far back in the mouth, but is fixed in the chin to increaſe its length, while at the further end it is forked. We ſee it ſaunching out this monſtrous tongue in catching flies; perhaps alſo with this it rakes mud. At (*b*), behind the root of the tongue, is the ſlit-like opening of the trachea; this is what is called the glottis in the human ſubject. We ſee this rima opening and gaſping for air when we keep the mouth thus diſtended; it has no epiglottis or valve to defend it; its own contraction is ſufficient, for when cloſed you cannot even gueſs at its place; beſides, the jaws force down the air into it, and the long tongue carries the food over it into the gullet. At (*c*) is ſeen th[illegible] opening of the gullet, which when dilated is as wid[illegible] as its jaws; it looks more like the ſtomach opening directly into the throat; and this great width require[illegible] a very ſtrong muſcle to contract it, and makes a grea[illegible] circle of rugæ. At (*d*) is ſeen the moſt importa[illegible] part of all, the noſtril of the Frog, with which [illegible] continually breathes, never opening its mouth.

Looking careleſsly upon this creature, we do n[illegible] perceive that it ever breathes, for it lies plunged ov[illegible] the mouth in water. It is never ſeen to open its mouth; there is no motion in its ſides like breathing; in ſhort it does not ſeem to breathe; and when it is provoked, (or rather through fear), though it ſtill keeps its mou[illegible]h cloſely ſhut, its ſides and back riſe, and it blows itſelf up apparently by ſome internal power. But when we obſerve the creature more narrowly, we percei[illegible]e that there is a frequent motion of its jaws, or rath[illegible]r of that ſkinny and bag-like part of its mouth which covers the lower jaw. We are apt now to fall into a worſe miſtake, for this bag under the jaw is alternately dilated and contracted, the mouth is never opened to take in new air; the creature ſeems to live all the while upon one mouthful of air, and ſeems to be playing it backwards and forwards betwixt its mouth and its lungs.

But, laſtly, when we obſerve its noſtrils, we find that there is in the noſtrils a twirling motion for each movement of the jaws, which makes the whole proceſs perfectly ſimple to our comprehenſion; for a Frog breathes by the noſtril alone, it cannot breathe by the mouth; it never raiſes its mouth above water, nor opens it but to catch flies or other food. If you keep its mouth open, you ſee it preſently ſtruggling for breath; for its reſpiration goes on in the following way: Its broad jaws are continually ſhut; they lock into each other by grooves; the mouth is completely cloſe, and forms a ſort of bellows, of which the noſtrils are the air-holes, and the muſcles of the jaws which come from the os hyoides draw in the draught by their alternate contraction and relaxation; and the noſtrils lie ſo obliquely over the hole in the ſkull, which is repreſented at (*a*) in the Plate at the end of this chapter, that the leaſt motion of them enables them to perform the office of a valve. Firſt there is a twirl of the noſtril which lets in the air; then a dilatation of the bag under the jaws, by which the mouth is greatly enlarged and filled with air; then a ſecond motion of that bag, by which the mouth is emptied and the lungs filled; then there is a ſlight motion of the ſides of the creature, by which the muſcles of the abdomen expel the air again; and then the twirl of the noſtril and the motion of the jaw ſucceeds again: ſo that with theſe creatures inſpiration is the ſwallowing of the air by their broad expanded jaws, with their coverings driving it down into the lungs; and expiration is the contraction of the abdominal muſcles driving it out again; and theſe two motions, when we obſerve a Frog attentively, are as perfectly regular as reſpiration in a Man. Their muſcles of reſpiration are not the muſcles of the belly but the muſcles of the jaws; and this cauſes the uncouth broadneſs of the jaws in Frogs, Newts, Lizards, Serpents, Turtles, &c.

Now we ſhall no longer wonder why the Frog never opens its mouth; why it never ſeems to breathe; why, after opening its belly, the lungs ſtill project; why, after emptying its lungs, it can fill them again at will, not by any peculiar power in the lungs, but by blowing them up with its jaws. If you gag the Frog and keep its mouth open, it cannot fill them, becauſe it cannot breathe; if you plug its noſtrils, it ſuffocates, though not ſoon; if you keep its mouth open by force, you ſoon find it ſtruggling for breath; and looking into its throat, you ſee the glottis opening from time to time*.

The Newt (or as it is called in this country, the Aſk) breathes with the jaws and noſtril like the

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* Dr. Monro in his explanation of Plate 16. ſhows us very obligingly the diaphragm of a Frog, marked (r).—This diaphragm is mentioned a ſecond time in explaining the ſame Plate.

Frog; it has, like the Frog, a conſtant motion by ſhort ſtrokes of the bag under the jaw (which bag is formed by the membranes of the mouth, covered and moved by the genio-hyoidei and mylo-hyoidei muſcles); but we obſerve that every minute, or leſs, it ſtops as if intending ſome particular motion; then gradually the bag ſwells out under the lower jaw to a great ſize; then the air contained in it is puffed down into the lungs with a ſudden flap of the bag; and in proportion as the jaws are emptied the long ſides of the creature are heaved up.

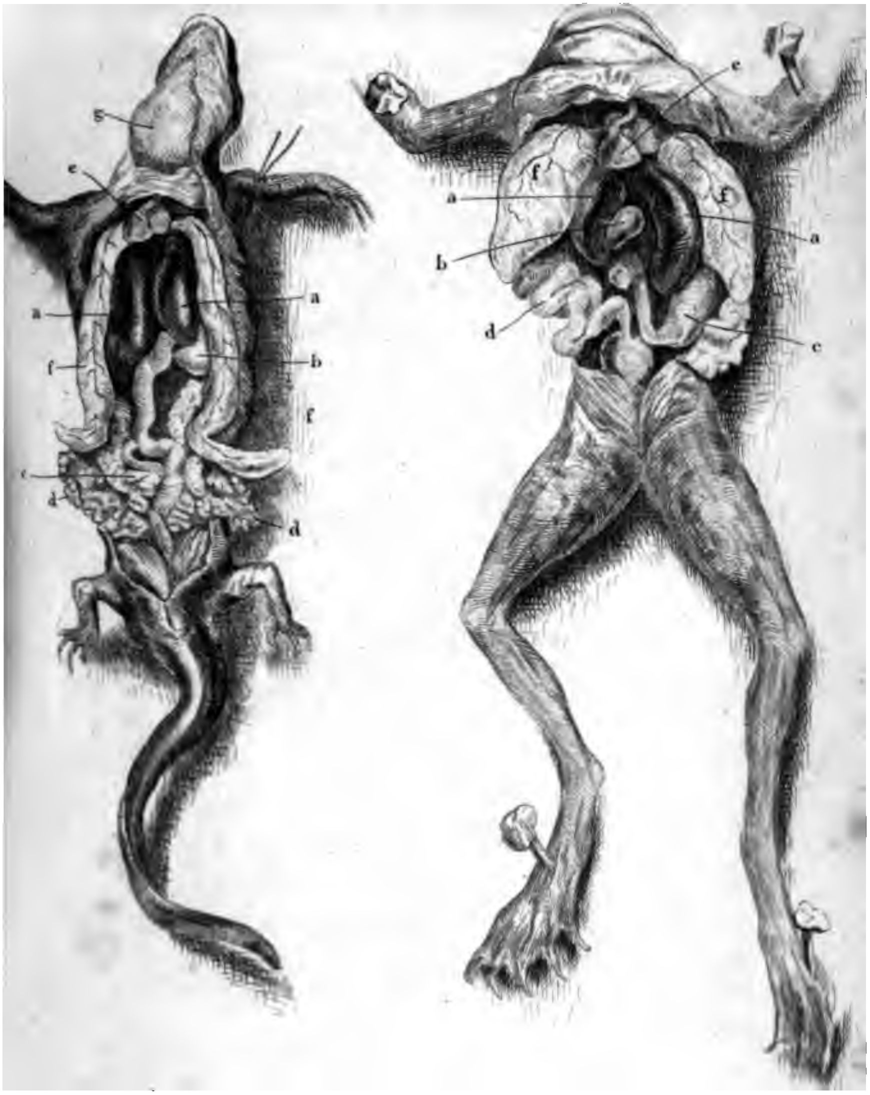
The Toad, the Chamelion, the Green Lizard, breathe exactly in the ſame way. The Chamelion has the flat broad jaws of the Frog; they lock into each other, and it never opens its mouth; it ſwallows its air in mouthfuls, drives it downwards into its lungs; its lungs are of a vaſt extent, ſtretching from the jaws all along the abdomen: it is the vaſt ſize of its lungs, almoſt concealing the abdominal viſcera, that makes Geſner ſay, " that of the entrails of a Chamelion the lungs only are viſible." The air it ſwallows in greater or ſmaller quantity as its needs or fears prompt it. When you alarm this timorous animal, it fills its ſides juſt as a Frog ſwells out its back; and either in this greater reſpiration, or in its ordinary breathing, we ſee it preſſing the air onwaards from cell to cell; and we ſee the motion proceeding from its jaws to its breaſt, and all along its ſides, till its lank form is quite puffed up almoſt to burſting.

All theſe creatures have, in addition to their peculiar reſpiration, a peculiar kind of lungs, thin, membranous, and extremely delicate: the lungs even of ſo great an animal as the Crocodile are, when inflated, very delicate and tranſparent, of a roſe-colour or ſlight red, conſiſting of delicate veſicles, and exactly like the Frog's lungs. The lungs of the Frog are in ſhape like a fir-cone, with the ſtalk of the cone on each ſide fixed to the ſide of the heart. But theſe conical lungs of each ſide are delicate, ſilvery, perfectly tranſparent, divided within into innumerable cells like a honeycomb; and theſe alſo are ſo extremely delicate, that though the outſide membrane is as tranſparent as a ſoap-bubble, the diviſions can hardly be ſeen, except by inflating and drying the lungs, and then cutting them. The lungs of the Aſk are ſtill more beautiful, as a ſpecimen of what are called membranous lungs; for the creature is very long in the body, its lungs run down along all its ſides; they are about the ſize of a common earth-worm or writing quill; they end like a blind gut; they are of a bluiſh-white, exquiſitely tranſparent, like the ſwimming bladder of a fiſh.

It is the nature of membranous lungs to oxygenate but a very ſmall quantity of blood; they are membranous, only becauſe there is not that vaſt profuſion of arteries, veins, and ſtrong veſicles, which there is in the human lungs. The pulmonic artery and vein are always, in the membranous lungs, extremely ſmall in proportion to the vaſt ſyſtem which they ſerve. There cannot be better examples of this fact than theſe two drawings of a Frog and of a Newt: In the Frog is ſeen the ſmall artery and vein ſpreading more ſuddenly over the lungs; in the Aſk is ſeen the ſame artery and vein, running down more directly,

and

Newt Frog



n the Frog aa is the Liver b the Spleen c the Stomach
the Intestines e the Heart ff its conical vesicular Lungs
n the Newt a the Liver b the Stomach c the Intestines
Ova dd the Ovaria or Egg-beds e the Heart ff Thin vesi
cular Lungs which are long like Intestines & transparent
ke the swimming bladder of a Fish g the Bag of the
by which the Lungs are blown up

and for a greater length along its worm-like lungs: in both we ſee the artery to be little bigger than the ranular arteries of the Frog's tongue at the head of the chapter. The manner of its coming off from the aorta is ſeen in the firſt plan in the book, where figure 2. repreſents truly the Frog's heart; and there we may obſerve how ſmall a proportion the pulmonic artery bears to the reſt of the arterial ſyſtem.

From theſe peculiarities of the membranous lungs, it is plain that the oxydation of the blood is a proceſs of ſmall importance in their ſyſtem; that this proceſs being of little value with them, they are the better enabled to go into the water, and to want breath for a time. But chiefly it appears, that the meaning of this peculiarity is not ſo much to give them the privilege of Amphibiæ, in allowing them to go into the water; for many creatures, as the Chamelion, all the tribe of Lizards, Newts, Toads, Serpents, &c. have theſe lungs, and yet never approach the water: but that the chief uſe of it is to eſtabliſh in this claſs of animals a peculiar conſtitution, a permanent, almoſt inexhauſtible, irritability, and a tenaciouſneſs of life; which, I believe, no creature, whether of the land or the water, wants, which has membranous lungs. And when we are told that theſe creatures can be kept two days under water, as a proof of their being Amphibiæ, I cannot but conſider it as a very childiſh proof; for, in the firſt place, we ſee them breathing with wonderful regularity when out of the water; when plunged into the water, we ſee them very ſoon ſtruggling for breath? and if they can live for two days without air, it is only becauſe they could bear any other kind of injury with equal eaſe, and could live two days without their heart or their head.

FOURTH SPECIES OF RESPIRATION, VIZ. THAT OF FISHES.

IN this ſpecies of reſpiration the creature breathes neither water nor air, but water mixed with air, and this office is performed by gills in place of lungs.

The reaſon why I have called this a ſpecies of reſpiration, needs to be very fully explained; for, though little obſerved, it is a certain fact, that a creature, without any apparent change upon its ſyſtem, can do well, having its blood oxygenated at one time by gills, at another time by lungs. The Frog, for example, lives long in the water; while it does ſo, it may be conſidered as a fœtus which cannot breathe: the young Frog, which has not yet acquired its proper and natural reſpiration, breathes like a fiſh. For the firſt fourteen days after hatching from the egg, and while the Tadpole is very ſmall, it has gills, which are two long, projecting, fimbriated appendages like fins; by the thirty-ſixth day theſe appendages are taken into the jaws, and form four rows of gills on each ſide, regular, and like thoſe of a fiſh; but at the ſame time, this fœtus has its lungs within the body, not to be uſed till it come out into the air, when the lungs aſſume their function and the gills ſhrink. The ſame ſyſtem in this inſtance, which was at firſt ſerved by gills, is in the end oxygenated by lungs.

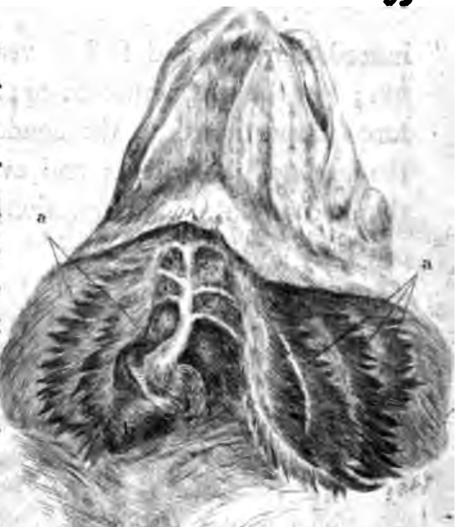
The motion of the gills in fiſhes is a true and perfect reſpiration: for, in the firſt place, if there be no air in the water, or not enough of air, they cannot breathe; diſtilled water is to a fiſh what the vacuum of an air-pump is to a breathing creature: if you exhauſt water with an air-pump, if you boil it, if you diſtil it, if in any way you deprive it of its air, fiſhes cannot breathe in it, but come up to the ſurface and gaſp for air. If you take a fiſh out into the air, it is the ſame with plunging any breathing creature into water, it gaſps and dies. Fiſhes cannot breathe in air wanting water, for that element is not accommodated to their ſpecies of lungs; nor in water wanting air, for then there is no oxygene; and we find, upon extracting the air from water which fiſhes have breathed, that it is contaminated, exactly in the ſame way with air which had been breathed by any breathing animal, that it differs very little from that in which a candle has burnt out. This is the reaſon that when many ſmall fiſhes are incloſed in a narrow glaſs, they all ſtruggle for the uppermoſt place, and that when in winter a fiſh-pond is entirely frozen over, you muſt break holes for the fiſhes, not that they may come and feed, but that they may come and breathe; without this, if the pond be ſmall, they muſt die.

In the reſpiration of fiſhes, there are two curious points to be conſidered: Firſt, The manner in which their reſpiration is performed; and, ſecondly, The manner in which their blood, when thus oxydated, is diſtributed over the body.

The red part or gills, which ſerve as lungs, lie under a broad ſcale, which defends them from all extraneous bodies, or hurt, or preſſure of any kind, for they are exquiſitely delicate. Their reſpiration is like the Frog's in this reſpect, that they ſwallow the water with their mouths; and in this it is like the fowls, that they drive it through among their gills, which lie perfectly paſſive like the true lungs of a fowl.

A fiſh's gills are ranged in ſemicircles under the great flap which covers them four or five ſemicircles on each ſide; the fiſh opens its mouth wide, fills it with water, ſhuts the mouth, then drives the water backwards, ſo that it lifts the great flap and makes its way out behind, and ruſhes with a ſort of ſtream through among the red gills, raiſing each ſemicircle from another, and making the water play freely round each feathery-like proceſs. It ſeems to me, that wherever this mixture of water and air is uſed, there muſt be ſome force to give impreſſion to the air upon the blood. The depth to which fiſhes go, and the preſſure of the water, muſt give ſome effect in impreſſing the air upon the lungs The gill muſt play more or leſs ſtrongly according to various depths, juſt as the fiſh muſt ſwim more ſtrongly againſt a ruder ſtream. Some fiſhes, as the Trout Perch, Salmon, Herring, have more open gills, ye they do not want this power of impreſſing the air more or leſs ſtrongly againſt the gills. The Eel and

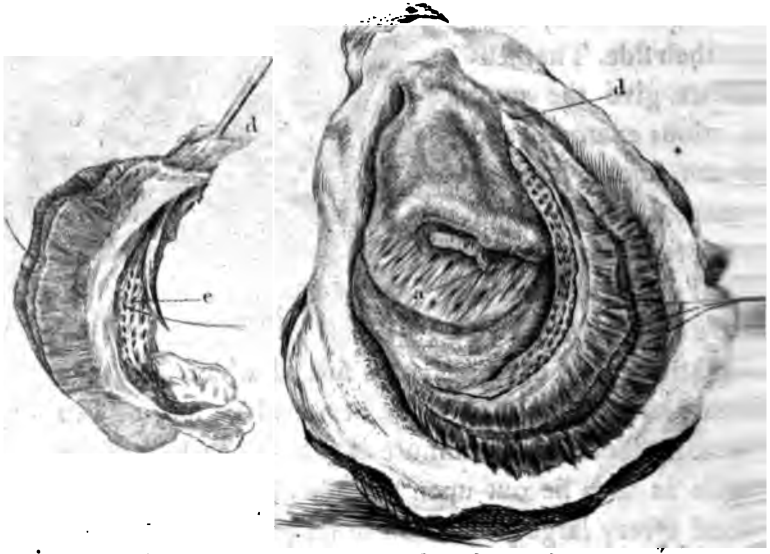
the



a. Gills of a Trout—b Its Heart
c c. the Arteries of the Gills

the flat fiſhes, as the Skate, have their gills more concealed. They ſwallow the air by the mouth, and breathe it out by holes in their ſide. The ſhell-fiſhes give the moſt curious example (and none more ſingular than the oyſter) of very regular and beautiful gills; and therefore I have given two ſlight marginal drawings; the firſt of which ſhows the heart and lungs at (*a*)—The heart, which may be ſeen beating about 40 in a minute at (*b*)—The whole of the gills as they lie out upon the ſide of the Oyſter, and bear a very large proportion to its body, at (*c*)—The canal, partly opened, in which the water paſſes to the gills from the mouth (*d*)—And at (*e*, figure 2.) is ſeen, ſeparated from the body, a long canal opened; before it was laid open, it was ſomewhat of a triangular figure within; it conſtitutes the baſis of all the circles of gills; it contains the moſt beautiful ranges of holes that can be ſeen in nature, by which, as is very plain, the water is admitted to each feather of each gill. The fiſh ſwallows the water by its mouth, which is at (*d*, figure 1.)—drives it down into this great canal, and ſo out again. It is by this, I am perſuaded, that merely the ſoaking of a fiſh's gills in water would not do, for they might have lain abroad, as

indeed they do, and ſoaked very ſecurely in a ſhel
fiſh; but the water muſt be applied with a degree
force proportioned to the condition of the lungs,
the needs of the ſyſtem; and every fiſh, whatever
the mechaniſm of its reſpiration, has this power.



Having explained this firſt point, viz. the mechaniſm of their gills, I proceed next to explain the circulation of their blood, how their blood is oxydated, and how it is diſtributed over the body.

A fiſh and an amphibious animal have both of them the ſimple heart, conſiſting of one auricle and ventricle, but with this ſingular variety, that the Frog, for example, wants the heart belonging to the lungs, a ſmall artery only from the common ſyſtem performing the office; while the fiſh again wants the heart, which ſhould circulate the blood through the body, and has that heart only which belongs to the lungs. The whole blood of the fiſh paſſes through this ſingle heart, and therefore the whole maſs circulates, parcel by parcel, through the gills, for every time that it circulates through the body. We ſhall begin its circulation, then, at the heart. Firſt, The whole blood of the body is returned into the heart of a Skate, for example, by two great veins (*a a*)—Theſe two great veins deliver it into a vaſt auricle, or reſervoir rather, which lies over the heart (*b b*)—The auricle delivers it into a ſtrong ventricle (*c*)—whoſe action is further ſtrengthened by the action of its aorta, which from the heart up to (*d*),—where the valves are, is very muſcular and powerful, and conſtitutes, in a manner, a part of the heart. But this great veſſel muſt in this ſpecies of circulation change its name, for it really is not an aorta, has nothing to do with the body: both the heart of a fiſh, and this its only veſſel, belong entirely to the lungs or gills; and as theſe are called the bronchiæ, this is the bronchial artery. The gills of this fiſh are five in number on each ſide, and on each ſide the bronchial artery gives out two branches (*e* and *f*)—which ſerve the five gills:—(*e*) the lower branch is large, and ſerves the three lower gills—(*f*) the higher branch, which goes off like one of the arms of a croſs, ſerves the two upper gills.

Secondly, Theſe arteries being diſtributed along the gills, divide into exquiſitely ſmall branches producing that feathery appearance which is ſo beautiful. Thoſe minute ſubdiviſions of the bronchial veſſels expoſe the blood to the air. This may explain to us how in the human lungs the expoſing of the blood, even with the interpoſition of membranes and of the

It is plain by theſe expreſſions of admiration that I do not mean to attempt ſo difficult a ſubject as this at preſent: I only mention difficulties which it is ſurpriſing that others have not declared and inveſtigated, for nothing can be more intereſting. The little that we do know ſhall be ſimply and plainly told.

The forms of inſects are often very ſtrange, their lives very irregular, ſometimes in water, ſometimes in air; many of them begin in Worms, and end their lives as Flies and Moths; and according to theſe varieties of their form, or life, or generation, their air-tubes are various.

Sometimes, as in the common Bee, they have nearly the form of lungs: They begin like two bags, reſembling thoſe of the Alga Marina, or ſea-weed, in ſhape; and theſe bags diſtribute pulmonary tubes, with occaſional bag-like dilatations in the courſe of the tubes, through all the body. More commonly the air-tubes of inſects are direct tubes, mere tracheas, of a very ſingular conſtruction; they have rings like the tracheas of animals; they have a delicate membrane covering theſe rings and forming them into a tube: the tube continues always rigid like a flexible catheter, or other tube of twiſted wire not liable to collapſe: They begin by many open mouths opening along the ſides of the inſect, and they terminate in myriads of veſſels, which, in their forms and progreſs over the various parts of the body, reſemble blood-veſſels more than it is eaſy to conceive. Theſe air-tubes being thus rigid, are always full of air, and by their refractions through the tranſparent parts of the inſect's body they give it in the microſcope a great degree of brilliancy;

ſhort ſketch, underſtand how the whole function goes on.

FIFTH SPECIES OF RESPIRATION, VIZ. THAT OF INSECTS.

There is in this kind of reſpiration no breathing organ like the lungs, but tracheas or air-tubes by which air enters into all parts of their body.

What is moſt perplexing in this ſpecies of reſpiration is the prodigious quantity of air which theſe creatures receive; the little connection betwixt the air-tubes and the heart; the impoſſibility of tracing blood-veſſels from the heart to the various parts to nouriſh them; and the clearneſs with which we ſee their air-tubes branching over all parts of their body. The ſtomach, bowels, and other viſcera, the legs and wings, even the very ſcales of inſects, have branches of the air-tubes dividing over their ſurfaces like the delicate veſſels of leaves and flowers. In ſhort, the magnitude of theſe air-tubes is quite ſurpriſing; and their branchings are ſo minute, delicate, univerſal over all the body, that it looks almoſt as if the air-tube had exchanged functions with the heart and arteries.

It

round the inteſtines and ſtomach of a Worm; and it is not to be forgotten, that though the beginnings of theſe tubes in their great tracheas and near the puncta reſpiratoria are quite tranſparent, their extreme branches are beautifully white like veſſels filled with chyle, or rather one might be apt to miſtake them for nerves.

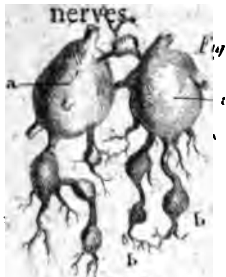


Fig. 3

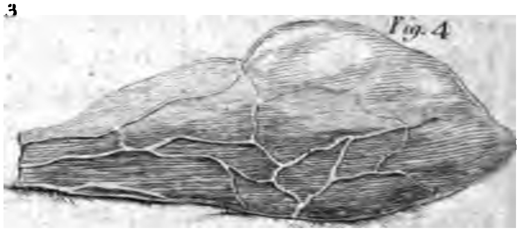


Fig. 4

Of the way in which this function is performed, there muſt be more varieties than we can know or comprehend: this we may ſafely conclude from the little that we do know, finding the variety ſo very great.

Almoſt all inſects have their puncta, like thoſe of the Caterpillar, ranged along the ſide, and inoſculating like thoſe of the Louſe from branch to branch: often the puncta open along the ſides; but in place of inoſculating from branch to branch, all round one ſide, they inoſculate acroſs the belly, the one ſide communicating with the other. This is beſt obſerved in the ſmall Worm from which the Bee proceeds (vide Fig. 6.), which is a magnified drawing of the Bee-worm. And here it muſt be obſerved, that, as in other inſects, always the ſtigmata or breathing points correſpond neatly with the folds or rings while it continues a Worm, and with the ſcales or diviſions of the body when it becomes a Fly; in the Bee-worm alſo the inoſculations anſwer to the flexures or joint of the body.

Ofte

Often when the inſect lives in water, it has only two punčta reſpiratoria: theſe punčta begin either in the ſnout or in the tail; they are the openings of two great air-tubes which run down each ſide of the inſect like two aortas, and the inſect has means of riſing to the ſurface, takes down a bubble of air along with it, and diſcharges a bubble of air before it riſes again: of this nature are the air-tubes of that Worm from which the Ephemeris proceeds. The ſketch of the Ephemeris and its air-tubes is given in figure 7.—This Fly has but two ſpiracula; they are ſo ſmall towards the neck, where their commencement is, that their mouths cannot be eaſily found. The two great air-tubes (*a a*) are ſeen like two aortas running all along the body, and their minuter branches (*b b*) are ſeen ramifying beautifully upon the abdominal muſcles and other parts. Many inſects are aquatic when firſt they are hatched from the egg. They have little gills which ſerve them while they continue in the water, as, for example, the Ephemeris Fly; but along with theſe gills they have the ordinary ſtructure of air-tubes, and the day on which they emerge from the water, the gills ſhrink, and the air-tubes begin their function; and theſe changes ſucceed each other very rapidly in all inſects, but moſt eſpecially in the Ephemeris, which is deſtined to live but one day.

It is moſt of all ſingular, that in ſome inſects the number of reſpiratory points, or puncta, changes according to the various conditions or ſtages of their exiſtence. For example, a Worm which crawls among the duſt, ſince it muſt breathe leſs eaſily, has more puncta than when it has changed its ſtate to that of a Fly, and has its puncta very freely expoſed to the air: in the Rhinoceros Beetle the Worm has more puncta reſpiratoria, and cloſer, becauſe it crawls on the ground amidſt mud or duſt; they are leſs numerous in the Fly, as its air-holes are always more freely expoſed; and when the Beetle is actually flying, thoſe puncta which were cloſed by the caſes of the wings are fully opened; ſo that the inſect breathes more freely, and perhaps its body is lightened, ſo that it flies more eaſily: it is alſo particular, that in the full-grown Beetle, though the puncta be leſs in number, the lungs are enlarged, they both change their form and become more capacious; for the tubes are mere tracheas or ſtraight lines, with direct branches in the Worm, but in the Beetle they are dilated from point to point into air-bags.

Inſects in general are bred in eggs, transformed into Worms, aſſume then the form of an aurelia, that is, of a Fly, ſmall but full formed, with its legs drawn up, its wings plaited and folded, ready at all points to burſt from the covering which ſurrounds it; for both in poſture and in the membranes which ſurround it, it reſembles a fœtus. In theſe three ſtages it ſtill is nouriſhed by air-tubes: they open by puncta reſpiratoria while it remains a Worm; the ſame puncta ſtill ſerve it while it is wrapped up an aurelia or concealed Fly; when the Fly burſts out, the ſame puncta, the ſame tubes, which have ſerved in its former ſtages, ſerve it ſtill; only this is moſt curious, that when from a Worm it proceeds a Fly, the ſkin which it rids itſelf of (crawling out of it and puſhing with its feet) carries off along with it many of the internal parts; the mouth, the anus, and eſpecially all the reſpiratory tubes, loſe an internal ſkin, at the ſame time that the old ſkin or ſlough is puſhed off from the outward ſurface of the body; and when the *puncta* are thus changed, they are left more open than before, and often their number is changed. For the drawing of this ſlough or ſkin (*a*)—from which the Worm has juſt diſengaged itſelf, and the old air-tubes (*b*)——inverted, and adhering to the caſt ſkin, ſee figure 8. which is the figure of the Coſſus, an affected name by which Mouffet and others have choſen to diſtinguiſh the Worm from which the Horned Beetle proceeds.

Theſe are the various ways by which inſects are ſupplied with air; and nothing can be more intereſting than to obſerve the vaſt proportion of air which they draw in, as if they lived upon that element; the infinite care with which Nature has guarded this main function in inſects, ordaining ſo many various ways by which they may in ſome ſenſe fill their ſyſtem with air. The variety of ways is changed, and ſuited, as I have obſerved, to their various ways of life, and to the various conditions and ſtages of their life; while they are Worms, when they are involved fœtuſes, and when they have burſt their ſhell and are full grown. In ſhort, Worms, aureliæ, Flies, Beetles, Bees, and all forms of inſects, have all of them their tracheas by which they breathe a wonderfully large proportion of air.

Fig. 7

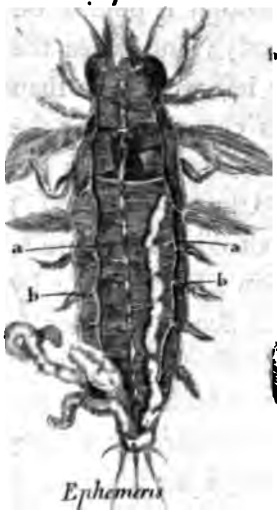
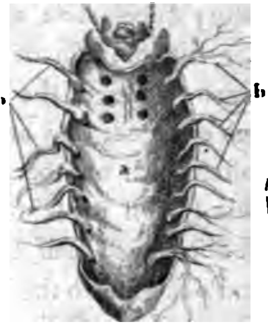


Fig. 8



Cossus
Fig. 8

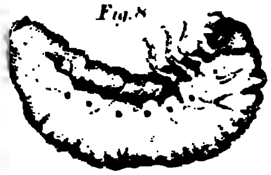
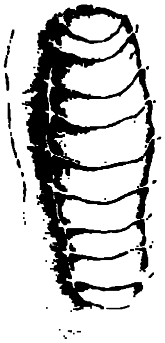


Fig. 6

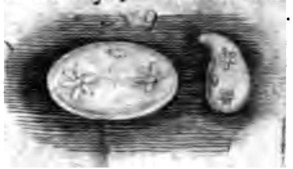


Bee Worm

There can be no miſtake concerning the function of their air-tubes and of their heart; it is ignorance or inattention only that can cauſe confuſion: the heart of a Caterpillar, of a Snail, of the Worms from which various Flies are produced, are ſeen diſtinctly through their tranſparent body, running down their back in form of a tube, ſometimes ſlightly oval, ſometimes having frequent dilatations, always throbbing with diſtinct and equal ſtrokes.

Nor can there be any miſtake that it is air they breathe; for before we diſſect an inſect, we muſt kill it; the contortions of a live Caterpillar prevent all deliberate diſſection, or even a view of the parts; we may poiſon the inſect, as with turpentine or ſpirits; we commonly drown it: this is done by immerſing it in a little tepid water. Nay, we find a thing which is at firſt inconceivable to be really true, that notwithſtanding the inoſculations of the air-tubes with each other, which ſeems to provide againſt all ſuch effects, when we cloſe up the ſtigmata of an inſect one by one, the parts become in the ſame proportion paralytic; if we varniſh over the ſtigmata of one ſide, that ſide becomes paralytic; if we varniſh over the ſtigmata of both ſides up to the laſt holes, the inſect lives, but in a very languid condition, it ſurvives in a kind of lethargic ſtate for two days, without any pulſation in its heart; if we alſo ſtop the two higheſt holes, it dies.

Of all the examples of reſpiration, that which is reported by Spallanzani is what I moſt wonder at, and cannot but doubt. In aceſcent liquors, or the juices of animal bodies, animalcules are ſeen plainly with ſimple glaſſes, moving ſometimes rapidly, ſometimes ſlowly; but never hitherto has any author pretended to ſee their lungs or heart. Mr. Spallanzani ſays, "that theſe animalcules are elliptic bodies; that in the centre of each ellipſis he ſees two ſtars, which are in conſtant alternate and regular motion, whether the creature reſts or moves. Each ſtar-like body has in its centre a ſmall globe, and every three or four ſeconds the globules are blown up ſlowly to three or four times their natural ſize, and as ſlowly compreſſed again; and every time that the radii are inflated the central globule ſubſides. On one ſide of theſe ſtar-like bodies there is an oval part, which is continually agitated with a trembling motion; he calls the ſtar-like bodies lungs, and the oval



body he thinks is the heart." Spallanzani ſurely has forgotten that he is ſpeaking of lungs in an aquatic inſect: if theſe ſtar-like bodies have any ſuch uſe, they muſt be gills.

Theſe are the animalcules which Buffon called organic germs, and from which, as materials and pieces, he built up the animal body. But if all this be true, then the day is come which he little expected, when the organic particles, on the faith of which he built all his ſyſtem of generation, are proved to be living and moving animalcules, voracious of food, devouring each other, breathing air, and having a viſible pulſating heart; animalcules depoſited from the atmoſphere, and generating like other inſects of their kind.

Thus we are convinced of the importance of reſpiration, and the abſorption of air in all living creatures, from Man even to the meaneſt reptile; and not leaſt needful in the laſt and loweſt order, which receive in proportion a fuller ſupply of air than fiſhes, amphibiæ, or Man; one point chiefly confounds the little knowledge that we have on this ſubject, viz. that many inſects live beſt in the fouleſt air.

a the Noſtrils — b the Tongue

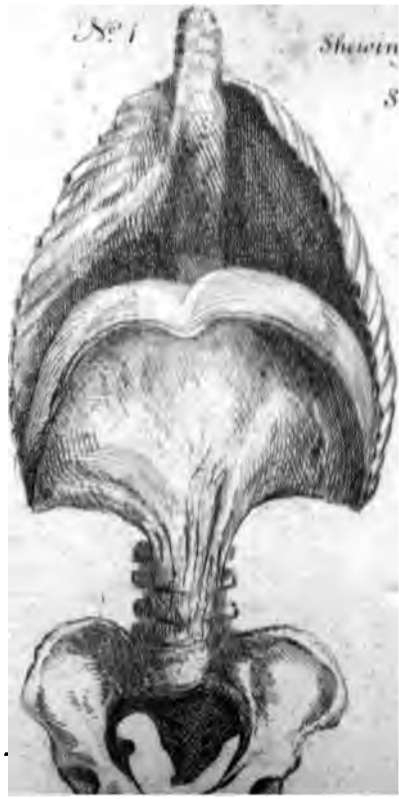
Plans of the Diaphragm

No. 1

Showing the Place and Form of the Diaphragm

No. 2

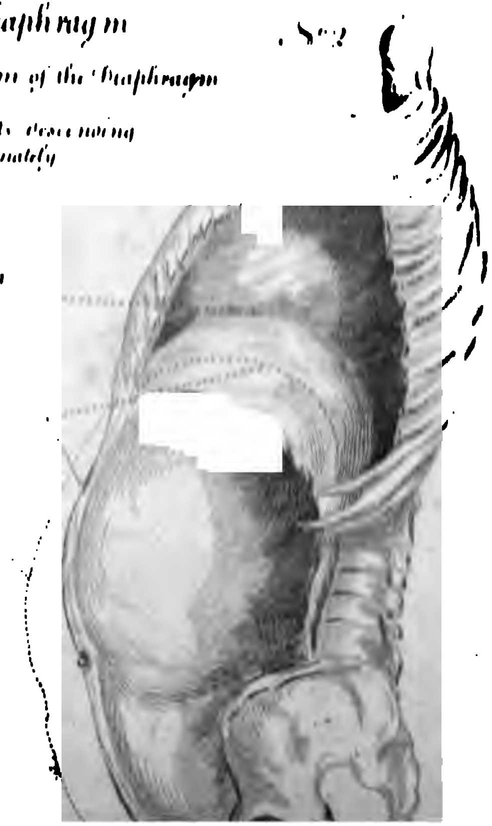
Showing the Effects of its descending & ascending alternately



Expiration

Inspiration

No. 2



CHAP. IV.

OF THE PECULIARITIES IN THE CIRCULATION OF THE FŒTUS.

THE peculiarities of the fœtus all relate to the oxydation of the blood, and are ſuch chiefly as fulfil the circulation of the blood without any need of its paſſing through the lungs, enabling the fœtus to live without that function in its mother's womb.

1. We are aſſured that the blood which comes to the fœtus through the umbilical vein is pure, or of greater value than that which the fœtus returns to the mother's ſyſtem. Either this blood is reſtored to all its properties merely by paſſing through the mother's ſyſtem, and what is thus drained off from the extremities of the mother's ſyſtem is more than ſufficient for the life of the child; or, without ſuch direct communication, the placenta performs to the fœtus a function equivalent to that of the lungs. Then this blood, whoſe value and properties muſt be loſt, if puſhed through the circulation of the liver, paſſes only in part through the liver, while a chief ſhare of it goes by a ſide paſſage, which is called the DUCTUS or CANALIS VENOSUS, under the liver, directly to the heart *.

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* *N. B.* The canalis venoſus is marked in the plan.

2. This blood does not paſs through the circulation of the lungs; perhaps it ought not to paſs; for there being no reſpiration, no air admitted to the lungs, the blood might rather be contaminated; perhaps it cannot paſs, the lungs never having been expanded with air: but, however that be, there is a ſide paſſage for conveying it from the right to the left ſide of the heart clear of the lungs. For this uſe is the FORAMEN OVALE, which is an opening of no inconſiderable ſize betwixt the right and left auricle of the heart; its area is as large as that of the vena cava; and it is ſufficient, without the help of the ductus arterioſus, to convey the blood freely from right to left.

3. The DUCTUS ARTERIOSUS ſerves quite another purpoſe; for though the circulation of the aorta is well maintained in the adult body by the force of one ventricle only, yet in the fœtus one ventricle will not ſuffice. In the fœtus the heart muſt puſh its blood not only through that ſyſtem of veſſels which is within the body, but alſo it muſt puſh it onwards through a ſecond circle of veſſels, viz. thoſe of the placenta; for the iliac arteries do not deſcend into the thigh and pelvis of the fœtus, but the iliac artery itſelf, with little diminution (very ſmall branches only being given downwards into the pelvis and thigh), turns upwards along the ſide of the bladder; and theſe two arteries going out from the navel, form the umbilical cord; and the heart of the fœtus has to give life and action not only to its own internal ſyſtem, but to theſe two arteries comprehending the chief bulk of the aorta, which run out to the diſtance of three feet along the umbilical cord, and which make wonderful

convolutions in the placenta, and terminate with extreme minuteneſs upon its ſurface. It is this which occaſions the neceſſity of the ductus arterioſus, which is merely a union or inoſculation of the pulmonic artery with the aorta. This union is formed by a great branch of the pulmonic artery in the fœtus, joining the aorta below its curve. This great branch (for it is greater than the two branches which go to the lungs) is named the ductus arterioſus, and may be defined an inoſculation betwixt the pulmonic artery and the aorta, ſo very large, that it gives the aorta of the fœtus twice its natural ſize and proportion, and enables the blood of that artery to have the full force of both ventricles; of the left ventricle through the aorta, and of the right ventricle through the ductus arterioſus by one ſynchronous ſtroke.

4. The contaminated blood of the fœtus muſt be returned to the mother, or at leaſt to the placenta; for which purpoſe the two iliac arteries are reflected along the ſide of the bladder as I have juſt explained. I ſay the iliac arteries without reſerve, becauſe the hypogaſtric and femoral arteries, that is, the arteries of the pelvis and thigh, though they are the largeſt branches of all the body in the adult, are in the fœtus extremely ſmall; and thence that ſmallneſs of the lower extremities compared with the largeneſs of the head, which characterizes the child, and which it takes years to redreſs.

DUCTUS VENOSUS.

THUS have I defined theſe parts and their uſes, in order that their ſtrict anatomy may be the more eaſily explained; and the part firſt mentioned, viz. the ductus venoſus, is the part the moſt difficult to be underſtood, and never without the help of a plan. In my plan I have endeavoured to elucidate theſe points.

Firſt, The mere anatomy, connections, and inoſculations of the veſſels; ſhowing how the umbilical vein brings in the blood of the mother; how that vein ſpreads in the liver and feeds all its left ſide with blood; and how the ductus venoſus carries part of that blood away from the circulation of the liver, conducting it directly onwards to the right ſide of the heart.

Secondly, I have endeavoured to explain what parts of the liver each branch ſupplies, and how theſe veſſels lie in the liver of a new-born child.

Thirdly, I have contraſted with this the change of form in theſe ſame veſſels, when, as happens in the adult, the form of the liver is changed, and the ductus venoſus and the umbilical vein are obliterated, and gone or converted into ligaments of very trivial uſe or ſize.

The blood from the maternal ſyſtem tranſmitted through the placenta, and oxydated, or having undergone ſome change equivalent to oxydation, comes down along the umbilical vein:—the vein enters by the navel, adheres to the inner ſurface of the abdomen, enters into the liver at the top of that great tranſverſe cleft which divides the liver into two lobes; and after entering the liver, it begins, as if it were the regular

P.

Fig. 2

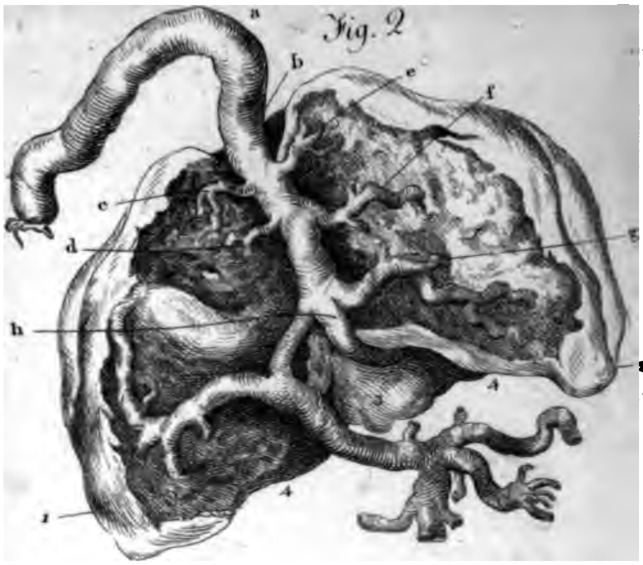
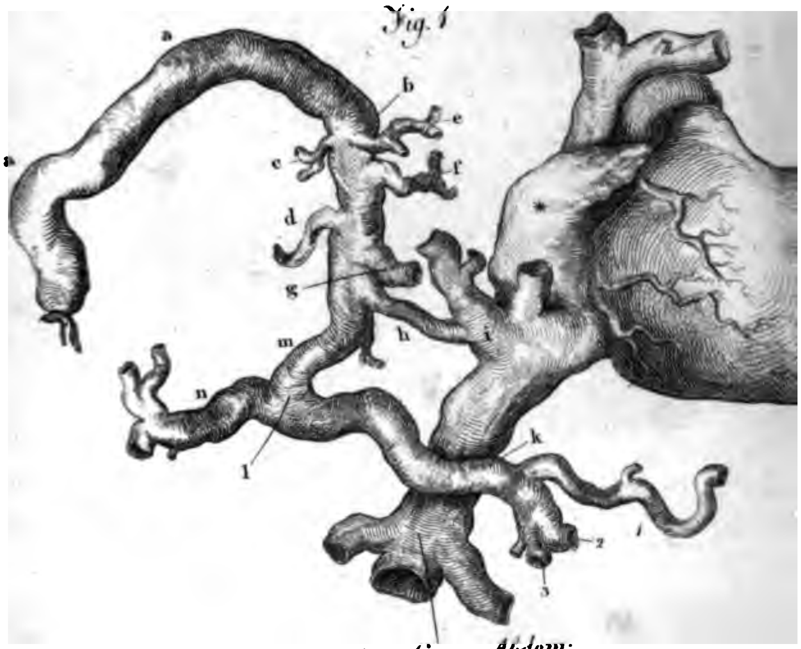


Fig. 1



Vena-Cava-Abdom:

regular and peculiar veſſel of the liver, to diſtribute branches through its ſubſtance from right to left.

In figure 1.—(*a a*) ſhows the umbilical vein—(*b*) the point at which it enters the liver—(*c*, *d*, *e*, *f*,) branches given to the ſubſtance of the liver, till at laſt it gives off (*g*)— a very great branch, which is indeed the chief trunk for the left ſide of the liver; it branches out in the liver like the oppoſite trunk, (*m*)—But I cut it off ſhort, leſt it ſhould confuſe the plan. Next comes (*b*)—the ductus venoſus, whoſe office is important, but whoſe ſize is not quite what we ſhould ſuppoſe. It comes off direct from the umbilical vein; its courſe is ſhort, and a little curved; it joins at (*i*)—the largeſt of the hepatic veins, *i. e.* of thoſe great veins which return the blood from the liver, and along with it goes directly into the right auricle of the heart, which is marked (*).—This, perhaps, might ſuffice as a deſcription of the ductus venoſus; but it is convenient, and will make a clear ſubject, to finiſh tha tcirculation of which this ductus venoſus is one of the chief difficulties.

This I conſider as the end of the umbilical vein, for here its circulation ends; or, if it ſends blood into the right branch of the vena portæ, its proportion is but ſmall. But the VENA PORTAE (which is juſt the collection of all the abdominal veins into one trunk,—of the ſplenic vein (1) —of the meſenteric vein (2)—of the hemorrhoidal vein, *i. e.* the vein from the pelvis (3);—the vena portæ, I ſay, compoſed of all theſe veins, is the true vein of the liver.

The branches of the vena portæ are gathered into a trunk at (*k*)—that trunk enters the liver at (*l*)—it divides into two great tranſverſe branches at (*m*) and (*n*)—the one ſerving the right ſide of the liver and the other the left; but in the fœtus this left branch (*n*) is not known as the limb or left branch of the vena portæ, but looks rather like the right branch of the umbilical vein; indeed, it is named ſo by Mr. Bertin.

But that I may not convey vague uncertain notions of veſſels apart from the organ which they are to ſupply, I have in figure 2. laid theſe veſſels upon an outline of the liver; by which I am ſure to explain correctly, 1. How the umbilical vein (*a*) enters at (*b*) into that great longitudinal cleft which parts the liver into two lobes. 2. How it begins, as if it were the peculiar veſſel of the liver, to diſtribute its branches (*c*, *d*, *e*, *f*,) from right to left. 3. How the laſt great branch (*g*) of the umbilical vein is the left trunk for ſupplying the left ſide of the liver with blood. 4. How the ductus venoſus (*h*) goes off in the moſt direct manner from the umbilical vein, and the faireſt for receiving its full proportion of blood; and how it carries that blood directly onwards to the back of the liver, or that part which touches the diaphragm, and there the ductus venoſus enters the heart *.

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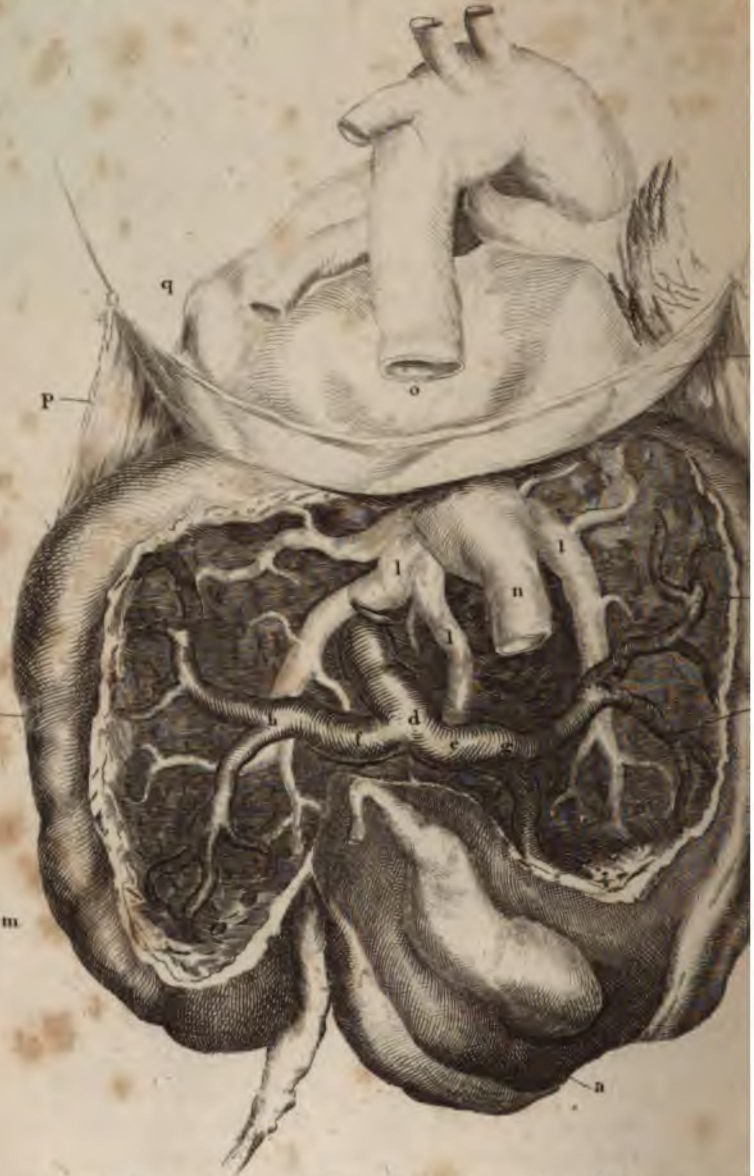
* The lobes of the liver in figure 2. are marked thus:—(1) The great right lobe—(2) The great left lobe—(3) The little lobe, or Lobulus Spigelii, lying betwixt them; and it ſhould be remembered, with regard to the poſition of the liver in this drawing, that it ſtands upright, as if pulled up by pulling at the umbilical vein (*a*)—or at the round ligament, which is the ſame thing (for the vein is converted into this ligament), ſo as to bring it into a perpendicular poſture, and ſhow the back line of the liver (4, 4)—where it touches the ſpine and diaphragm.

But

Third Plan of the Liver



n *is the Vena Cava Abdominalis* **o** *is the place where the Cava ente*
Auricle **p** *is the Diaphragm upon which the right Auricle lies and th*
arteries are seen above the Diaphragm **q** *being the apex of the heart*

But my third plan explains the adult liver as if theſe branches had never exiſted. The two firſt plans ſhow what are its veins in the fœtus. This third plan ſhows what are its proper and permanent veins; for thoſe peculiar veins which we find in the child are accommodations for the fœtus, are ranked among the peculiarities of the fœtus, and are, when the child is born, obliterated by a new circulation; and what is very curious, by a circulation which goes through the ſame veſſels in a retrograde courſe.

In this third plan I repreſent the liver of the adult; I conſider only the vena portæ, which is its proper vein, and I give the vein and the liver itſelf a new and more ſimple form. This plan is drawn from an adult liver, moſt of its ſubſtance being diſſected away.—(*a*) Marks the right lobe—(*b*) the left—(*c*) the lobulus Spigelii. Theſe are ſufficient to mark the more important points, and I have not ſpared the ſubſtance of the liver in other parts where veſſels were to be ſhown.—(*d*) Is the ſhape of the vena portæ tied after injection, and cut ſhort and twiſted a little ſo as to make it ſtand almoſt perpendicularly—(*e*) and (*f*) are the two great lateral branches going to the right and left ſides of the liver; and this cylindrical part of this very great vein is called the ſinus of the vena portæ. It is ſo formal, lies ſo fairly at right angles with the vena portæ, goes ſo regularly into two equal limbs, the branches too, even when ſpreading in the liver, are ſo formal, that it looks more like a piece of human mechaniſm than any thing belonging to the living body: it appears ſo here, not from the ſtiff and awkward forms which a plan muſt have, but becauſe it is thus in nature. The right branch (*g*) is diſtributed very formally to the right ſide of the liver:—(*h*) The oppoſite branch is diſtributed as formally to the left; and there is no mark or note by which it can be known that this left branch had ever proceeded from the umbilical vein, or been filled by it, or been anything but what it now appears, the left branch of the vena portæ correſponding moſt regularly with the right. And in the ſame way it may be obſerved, that the middle veins of the liver (*i*, *k*, *l*, *m*,) are now plainly known to be legitimate branches of the vena portæ, though they appeared in the fœtus to be proper branches of the umbilical vein: they are named ſo by Bertin and others, the beſt anatomiſts; but that they are plainly not ſo, becauſe the umbilical vein (ſince theſe branches go off at an angle) filled them only by a backward courſe, while here in the adult they are filled by their natural trunk, the vena portæ, in a more natural way.

Now, by glancing the eye from the circulation of the fœtus to that of the adult, we obſerve theſe changes: Firſt, The liver of the fœtus has blood circulating in two directions; the right ſide of the liver is filled from the vena portæ, the left ſide by the umbilical vein. The liver of the fœtus having two veins has a large quantity of blood, a growth larger than that of any of the viſcera; and indeed the liver alone ſeems to fill all the upper region of the abdomen. This is changed when the child is born; the umbilical circulation is cut off and the liver of the child ceaſes to grow but in proportion to the other parts*. Next, we obſerve in the fœtus how the umbilical vein runs into the left branch of the vena portæ, inſomuch, that the left branch of the portæ has not any determined form; nor has the ſinus venæ portæ, or the horizontal ſhaft of this vein, that peculiar and formal ſhape which I have already obſerved. This ſhape, then, of the ſinus venæ portæ, is not to be looked for in the child, and is not found in theſe plans.

Again, we find in the adult thoſe blood-veſſels obliterated which ſerved ſuch peculiar uſes in the fœtus; the blood which flowed formerly into all the left ſide of the liver by the umbilical vein now comes along the venæ portæ; theſe veins are now working their blood forwards in a retrograde courſe; the blood which flowed once in the direction (*i*) N° 2. runs now in the direction (*k*) N° 3.

In this plan are ſeen alſo the hepatic veins, or branches of the vena cava, in the liver. Theſe three great veins marked (*l l l*)—are the returning veins, which carry back to the heart that blood which the venæ portæ (aſſuming the office of an artery) circulates in the liver; and it is with one of theſe that the ductus venoſus joins before it enters the heart.

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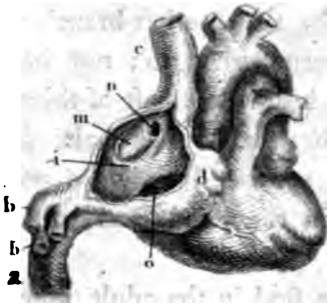
[*] One is forced to ſpeak this unphiloſophical language, though the ſize of the liver in the fœtus is as juſt and well proportioned to the fœtus, as that of an adult body is to an adult body.

Plan of the For. Ovale



FORAMEN OVALE.

The foramen ovale, the ſecond peculiarity of fœtus, is a hole of no inconſiderable ſize, tranſi ting the blood freely from the right to the left ſid the heart. Its uſe is obvious, even from a gen view of the ſyſtem; and when we look more clo into its mechaniſm, its uſes are completely explai Its valve being placed on the ſide of the left aur perfectly ſettles (and that by the only authentic pr the courſe of its blood: and, ſatisfied with the ſcription which I am now to give, I decline all

Explanation of the Plan of the Foramen Ovale.

(*a*) The aſcending cava, with its hepatic branches (*b* (*c*) The deſcending cava.—(*d*) The right auricle, where it lies a the roots of the aorta and of the pulmonic artery—(*i*) The iſt Veuſſenii, as it is called, or circle which ſurrounds the oval h (*m*) The valve of the foramen ovale—(*n*) A ſmall opening, we always find towards its upper part—(*o*) The opening to the ventricle.—This plan is intended chiefly for ſhowing th place of the foramen ovale; its anatomy and juſt form is bett preſented in the true drawing which ends this ſubject.

putes about the nature of this opening, or its valve. This is a ſubject which diſputes may perplex, but cannot explain. Another reaſon which I have for declining ſuch controverſies, is this: It is an eaſy matter to impoſe upon a whole academy, eaſier by far than upon one ingenious man: and thus it came to paſs that in the French Academy each theoriſt brought diſſections of the heart and foramen ovale ſuited to his own doctrines; each, when convenient, changed his ground a little, and brought new diſſections; and thus valves and auricles, fœtal and adult hearts, double Cats and human monſters, made their annual exhibitions in the halls of the French Academy: the Society never ſickened nor tired, and the rareeſhow laſted exactly one hundred years.

What kind of doctrines were current at ſuch a time it is almoſt ſuperfluous to explain; yet I think it not amiſs to remark two examples, of obduracy on the one hand, and of ingenuity on the other, in two of the greateſt men. Mr. Mery had conceived notions about the circulation of the blood in the fœtus, which can hardly be explained*; but it was one point eſſential to his doctrine, that the blood in the fœtus moved directly from the left auricle to the right. He was forced to deny that the foramen ovale had a valve; and this doctrine he continued, with ma quirks and tricks, to maintain to his dying day. M Winſlow agreed with Mery; he ſaid, that the foram ovale had no valve; that though it had a membran that membrane performed nothing of the office of valve; that the blood paſſed freely from right to le or from left to right, as occaſion required; that th the two auricles were as one. He forgot for a ti that there is but little circulation in the fœtal lung that the right auricle is filled with all the blood the body, while the left is filled very ſparingly by t pulmonic veins. From theſe data it is plain, that t balance muſt always be in favour of the right auricl that it always muſt be more full of blood; that wit out ſome valve the blood muſt ruſh with a contin preſſure from right to left; while, again, the place the valve is itſelf a demonſtration that the blood ca not paſs from left to right. Winſlow, when he for years after perceived that he had ſpoken idly up this ſubject, left Mr. Mery among his fooliſh arg ments and diſſections, and retracted all that he h written with a manlineſs of ſpirit which deſerves to recorded.

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* All that can be done towards the explaining it in one word is this: He "fancied that the right cavity of the heart was ſo large and the left ſo ſmall, that always the left ſide was obliged to diſgorge again upon the right ſide; and this was the meaning of the blood ruſhing through the foramen ovale from the left ſide to the right."

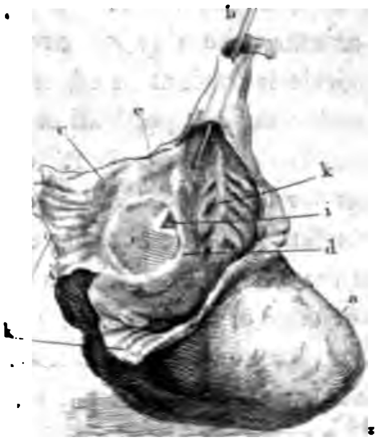
211 The foramen ovale is not ſtrictly oval, but is rath round. In the plan it appears oval, becauſe th I have endeavoured to repreſent the condition of t veſſels when the heart is dilated and the veſſels fu but when we lay it out for demonſtration or [illegible], it appears, as in the drawing, of a round

[illegible] is in the partition betwixt the t auricles [illegible] very backward point; for, in fact, auricles touch each other only behind; at their fore part they are ſeparated by the roots of the aorta and pulmonic artery, as may be ſeen in any of the plans. We look, then, for the foramen ovale at the very backmoſt part of the right auricle; or rather it is placed ſo high in the auricle as to ſeem to belong rather to the root of the cava deſcendens.—A ring riſes round the borders of the hole, very prominent, and exactly like the ring of the meatus auditorius internus in a child.—This was named ISTHMUS VEUSSENII; but this conceited name of iſthmus, which Veuſſens gave it, is quite unintelligible, and it muſt be changed for that of the CIRCULUS FORAMINIS OVALIS, the ring or circle of the oval hole.—This circle is thick at its edges; very ſtrongly muſcular, like the muſculi pectinati of the auricle; in ſo much that authors of ſome character have thought this a ſphincter for the oval hole. There is no doubt a kind of decuſſation of the fibres at each end of the oval hole; ſo that theſe fibres, forming a ſort of pillar on each ſide or edge of the foramen, the name of Pillars of the Ring, or COLUMNÆ FORAMINIS OVALIS, is leſs exceptionable; though theſe pillars, or any thing deſerving ſuch a name, will not be eaſily found by one beginning anatomy.

The valve of the oval hole lies entirely on the left ſide, as the round edges of the right ſide may demonſtrate. By taking the blunt probe, we find we can lift it towards the left ſide; but being puſhed towards the right ſide, it riſes into a ſort of bag, and oppoſes the probe. The valve is perfectly tranſparent; it ſeems delicate, like all the other membranous valves, but is really ſtrong. There is often left, after the cloſing of the valve, a ſmall opening at its upper part. The valve cloſes ſoon after birth: the hole is ſo large, that this membrane forms a very large ſhare of the partition betwixt the auricles; its tranſparency is ſuch, compared with the reſt of the walls, that it is as diſtinct in a boy, or in an adult, as in a fœtus.

This is the anatomy of the oval hole, and of its valve; and this proves, and any one who examines it will entirely be convinced, that the blood of the fœtus paſſes through it from right to left[*].

[illegible] of the Foramen Ovale .—



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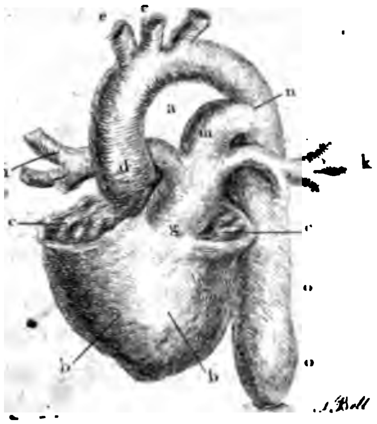
[*] This heart of a fœtus had all its parts cut away, except the ventricles (*a a*)—the vena cava, with a blow-pipe in it (*b*)—and the wall or partition betwixt the auricles (*c c*)—which is here unfolded, to ſhow the foramen ovale. The muſculi pectenati, or muſcular fibres of the auricle, are well ſeen at (*k k*).—(*d*) Is the circle of the valve, the annulus foraminis ovalis.—(*e*) Is the valve itſelf.—(*i*) Is the ſmall opening in the upper part of the valve, where the valve falls ſlack, and ready to open.—(*m*) Is one of the tricuſpid valves, or of thoſe valves

DUCTUS ARTERIOSUS.

The ductus arterioſus I have defined a great inoſculation betwixt the pulmonic artery and the aorta; not for the purpoſe of conveying away that blood which ſhould paſs through the lungs, but for giving to the blood of the aorta the propelling power of both ventricles: and how well it is able to perform this office, will be eaſily ſeen from the drawing on my margin †.

Ductus Arterioſus



The pulmonic artery of the adult divides, as has been marked in all my former plans, into two great arteries, one going to the right ſide, another to the left; but in the fœtus there ariſes a middle branch betwixt theſe two. It is larger than both put together; it is in the middle, and ſo comes moſt directly from the heart; it goes in a

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valves which guard the right auricle; and both this and the valve of the foramen ovale appears ſo bright againſt the blackneſs of the heart, becauſe they are tranſparent, and the light is made to ſhine through them, which is the beſt way of demonſtrating the valve of the foramen ovale.

† This ſketch is taken from a little preparation made on purpoſe, where a quill was thruſt in ſo ſtrongly betwixt the ductus arterioſus and aorta, as to ſeparate them unnaturally, and leave a ſpace (*a*) betwixt them.—(*b b*) Marks the two ventricles—(*c c*) the place from

ſtraight line towards the aorta, and joins with it immediately below the arch. This is the ductus arterioſus, the centre branch of the three branches into which the pulmonic artery of the fœtus is divided. It is bigger than the aorta in the fœtus; it gives the full force of the right ventricle to the blood of the aorta, in addition to that of the left. In the adult it is ſo thoroughly obliterated, that by the moſt careful diſſection we can ſhow no other veſtige of it than a cord-like adheſion of the aorta and pulmonic artery.

Theſe, then, are the chief peculiarities of the fœtus*; but the concluſions which have been drawn from this mechaniſm are, as I ſuſpect, very far wrong. But this I can in no ſhape prove, till I ſhall have firſt repreſented the real condition of the fœtal heart. Firſt, then let it be obſerved, that every drop of blood which comes into the ſyſtem is, either by the powers of the placenta, or by communion with the mother's ſyſtem, oxydated blood. —One part of this blood, indeed, paſſes through the circulation of the liver before it reaches the heart, while another paſſes more directly through the ductus venoſus; but both are mixed, and the blood is all of

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which the two auricles were cut away to make every thing clear—(d) The root of the aorta, known by (e e) its carotids.—(g) Is the root of the pulmonic artery—(i) the right and (k) the left pulmonic arteries—(m) the ductus arterioſus or middle branch, running into the aorta—(n) the place where they join—(o o) the aorta increaſed in ſize by this addition.

N. B. This heart is but a very little under the natural ſize in a new born child.

* The umbilical arteries muſt be explained in another place.

one quality when it arrives at the auricle, in order to fill the heart, and to begin its courſe round the body. Now, ſince the blood is all of one quality, Nature could have no cauſe for dividing ſuch blood into two portions; one to paſs through the lungs, the other to paſs over the body. She could have no motive for employing, as in the adult, two hearts. The deſign of Nature plainly is, to prepare a double heart, and keep it in reſerve for the circulation of the adult, but to uſe it as a ſingle heart in the fœtus. And ſee how ſimply this is accompliſhed. The two auricles communicate ſo freely by the foramen ovale, that they are as one: the two ventricles both deliver their blood into one veſſel, the aorta; and they are alſo as one. The blood arrives by the cavas, fills the right auricle, and in the ſame moment fills, through the foramen ovale, the left auricle; ſo that the auricles are as one, and filled by one ſtroke; the two auricles act at once, and ſo the ventricles alſo are filled by one ſtroke; the aorta receives the blood of both ventricles at one ſtroke. So that, in the ſtricteſt ſenſe of the word, the fœtus has but one ſingle heart, the heart of the body (the function of the lungs being performed by the placenta, far from its proper ſyſtem); and when the function of its own lungs begins, then Nature, by the ſimpleſt of all mechaniſms, divides the two hearts, that they may perform each its peculiar function. Firſt, the flow of blood into the lungs deprives the ductus arterioſus of blood; and, ſecondly, this flow of blood coming round to the left auricle of the heart reſtores the balance, preſſes down the valve of the foramen ovale, and makes the partition betwixt the

auricles entire. In ſhort, while the oval hole a
ductus arterioſus are open, it is a ſingle heart; a
when they cloſe, as they do the moment the child
born, it becomes the double or perfect heart.

Now the miſtake which all phyſiologiſts have fall
into is this, They have not obſerved that no cr
ture can live with a ſingle heart, which has the ox
dation of its blood performed by lungs. A fiſh li
by a ſingle heart, becauſe its blood is oxydated
gills, not by lungs; Inſects live with a ſingle hea
as their lungs, or the branches of their lungs, are d
tributed like arteries over all their body; The fœ
can live with a ſingle heart, becauſe its blood is ox
dated by the placenta. And that this idea may ma
a more determined impreſſion, it will be good
prove, that the function of the placenta actually
equivalent to the function of the lungs; and tha
is the placenta itſelf that produces this change up
the blood, I am the rather inclined to believe, beca
we ſee the veins and arteries of the Chick ſpreadi
over the membranes of the egg, and we can obſe
the artery ſending dark-coloured blood into the
membranes, while the vein brings back florid
oxydated blood.

If, during child-labour, the umbilical cord fa
down before the head of the child, at firſt it is
preſſed but beats ſtrongly, and the fœtus is felt ſtru
gling in the womb; but when, after a few pains, t
head deſcends into the pelvis, the cord is preſſ
betwixt the head and pelvis, the pulſe falters, ceaſe
the child ceaſes to ſtir in the womb; and if
born in a few minutes is irrecoverably dead, and

black in the face like one ſtrangled or drowned. When a child comes with its feet or other parts of the body firſt, the head being laſt delivered, is difficultly delivered; the accoucheur ſtruggles long in bringing out the head; the umbilical cord is compreſſed all the while, and the child dies. The ductus arterioſus, nor the oval hole, cannot ſave the child, for it dies becauſe it is deprived of the function of the placenta, which is the fœtal lungs; and this is the cauſe why it appears like one ſuffocated or drowned.

When the child is born, lay it upon your knee, the cord being uncut, and you will obſerve that the one function declines exactly as the other ſtrengthens: That if the child do not breathe freely, the cord will continue to beat ſteadily, the placenta ſtill continuing to perform the function of the lungs: That when the child begins to cry freely, the pulſe of the cord and the function of the placenta ceaſe at once. If the child breathe freely, but yet do not cry, and you tie the cord, it is inſtantly forced to cry for a fuller breath; and if a raſh perſon tie the cord prematurely, when the child neither cries nor breathes, he cuts off the function of the placenta before the function of the lungs is eſtabliſhed, and often the child is loſt: this, in the hurry and officiouſneſs of ignorant women, happens every day. If even after two days the child's breathing be much interrupted by coughing, crying, or any ſpaſmodic affection of the lungs, Nature ſeeks again the function of the placenta, and the pulſe returns into the chord ſo as to raiſe it from the belly of the child. Theſe things prove what the beſt phyſiologiſts have forgotten, or have not known, that the fœtus has, in the function of the placenta, ſomething equivalent to the function of the lungs.

One great miſtake then runs through the whole of phyſiology. It has been univerſally believed that the free and eaſy tranſmiſſion of the blood was the chief uſe of the lungs, as if they had acted like fanners to flap on the blood from the right to the left ſide of the heart. They affirmed, that either continued diſtention, or continued collapſe, hindered the progreſs of the blood; and they alſo believed univerſally, that if but the ductus arterioſus or foramen ovale, or any thing, in ſhort, were left open to let the blood paſs, that perſon might live in ſpite of hanging, drowning, or ſuffocation of any kind.

This will be found to be the moſt perfect of all abſurdities; and to alledge ſuch a thing againſt all authors requires ſome kind of proof: it will ſuffice, if I prove it againſt a few of the moſt eminent. So much were the older authors wedded to this miſapprehenſion of the dilatation of the lungs being uſeful only by driving forwards the blood, that, in the Pariſian diſſections, we find the following experiment made on purpoſe to prove the fact. "We have alſo made another experiment (ſay the Pariſian diſſectors*) to know more diſtinctly the neceſſity of the motion of the lungs for the entire circulation of the blood. An injection being made by the right ventricle of the heart into the artery of the lungs of a dead Dog, it happens, that if one continue to make the lungs riſe and ſink alternately by means of bellows put into his trachea, the liquor puſhed into the artery does eaſily paſs and go through the vein into the left auricle; but when one ceaſes to blow, it paſſes not but with a great deal of difficulty," (page 262.)—Which doctrine is dilated into its full abſurdity in the next paragraph. "Having viewed the difference of ſtructure in a Tortoiſe and in a Dog, it is eaſy to give ſome probable reaſon of the phenomena of theſe experiments; and the reaſon is, that it is neceſſary that theſe veſſels ſhall be dilated for the receiving of the blood of the right ventricle of the heart, and that they may be afterwards compreſſed in expiration to preſs out the blood, and make it paſs into the left ventricle." Swammerdam indeed ſays, concerning the Frog's lungs, that an artery goes over them, which has no other purpoſe but to nouriſh the lungs; and that it is of the nature of thoſe called bronchial arteries in Man. But the College of Diſſectors have plunged ſtill deeper into this remarkable blunder; for they ſay (page 261.), in ſpeaking of the lungs of Newts, Frogs, and other creatures which I have repreſented as having a pulmonic artery extremely ſmall in proportion to their ſyſtem, "that in ſuch creatures the lungs have merely that quantity of blood paſſing through their ſubſtance which is neceſſary for their own particular nouriſhment;" which is ſaying in the plaineſt terms, that they have lungs (only, I ſuppoſe, that they may be like other creatures); but their lungs are of no manner of uſe, except to nouriſh themſelves.

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* *N. B.* This was a wheel within a wheel; it was a committee of the great academy, who were ſeparated into a ſmaller ſociety for inveſtigating the organization of all ſtrange animals; and a very pretty account they gave of them, as ſhall be ſeen preſently.

One ſhould have thought that the folly of this opinion would have appeared more ſtriking in proportion to the earneſtneſs of theſe arguments, and that no ſubſequent author would have deigned to honour ſuch an opinion ſo far even as to notice it: but behold the celebrated Haller not only adopts this notion very fully, but enriches it with further explanations, ſaying, “that the veſſels are all, during the contraction of the lungs, forced into numerous angles and joint-like folds; that the angles are made even, and the paſſages of the blood more direct upon the expanſion of the lungs.” As if, forſooth, the lungs (which, as I ſhall preſently demonſtrate, ſcarcely move in reſpiration) folded and cloſed upon each other like the wings of a Butterfly or Beetle *. Santorini alſo repreſents the veſſels of the lungs as thus collapſed, plaited, and folded a thouſand various ways “affaiſſé et replié de mille manieres differents, &c.”—“One effect of expiration (ſays Haller) is ſo to compreſs all the arteries of the lungs, that they cannot receive the blood from the ventricle of the heart ſo freely as they are wont to do †.

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* “Præterea, in vivo animale, cujus cor contrahitur, et in arterias pulmonales ſanguinem data vi emittit, omnino nunc ſanguis in eas arterias facilius, atque adeo celerius irrumpit, poſtquam deletus retardatricibus plicis, recta nunc ſunt.”

† Verum alter effectus expirationis eſt utique pulmonis arterias ita comprimere, ut ne pari facilitate ſanguinem a ſuo cordis ventriculo recipiant.

"It muſt ſeem very ſtrange for me, after ſaying that inflating the lungs reſtores an animal after apparent death, and recovers the drowned, to affirm that long continued reſpiration is fatal*: and yet we need not look long for the cauſe of this; for during this long continued inſpiration, much blood muſt be gathered in the lungs, but none can get out†." Nothing is attributed, in his explanation, to the want of air, but all is attributed to the obſtructicn of the blood: yet if this were all, Amphibiæ would need no lungs, fiſhes would need no gills, inſects could need no air-tubes; for none of theſe aſſiſt the motions of the heart. Monro, who puts Haller to rights in every thing elſe, follows him in this. "In all amphibious animals, therefore," ſays Monro, "every part of the body may receive a conſiderable portion of blood, although the reſpiration and free paſſage of the blood through their lungs be interrupted," &c. (p. 21.) And the celebrated Blumenbach, the man moſt admired on the continent for his Phyſiology, ſays, at p. 80. "Poſt extremam reſpirationem redeunti per venas cavas ſanguini via ſueta in pulmones nunc collapſos præcludatur *."

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* "Paradoxum videri poſſit, ab inſpiratione ſanguinis in pulmonem commeatum expediri: inflato etiam aëre, quod genus eſt magnæ inſpirationis, animalia moribunda reviviſcere, et ſanguinis per pulmones iter revocari: et tamen hanc eandem, adeo faventem ſanguinis per pulmonem motui inſpirationem, ſola paulo diuturniori continuatione, anxietatem primo incredibilem facere, deinde, ſi vel voluntatis violento imperio tamen aer in pulmone retineatur, vel ab alia cauſa intra pulmonem copioſior ſervetur, denique ſaniſſimum et fortiſſimum hominem ſubito interire."

† "Hujus nunc anxietatis et ſuffocationis, et denique mortis cauſam non eſt arduum invenire. Adparet enim, ab inſpiratione diutius continuata, ſanguinem in pulmonem quidem advenire, et congeri, exitum vero ex pulmone non invenire."

Thus I have proved, that it has been the opinion down to the preſent day, that the collapſe or over-diſtention of the lungs are both equally oppoſite to the eaſy paſſage of the blood: but inſtead of going round about the matter ſlyly, as ſome leſſer authors have done, I like rather the manner of the Reverend Dr. Hales, who ſays plumply, "that ſuffocation conſiſts in the falling flat of the lungs," (p. 271.) He talks in this way, becauſe, like Buffon, Derham, Des Cartes, and ſome others, he was a philoſopher by inclination, and by force a ſort of an anatomiſt.

Now, the condition of the human lungs is quite oppoſite to all this; and alſo (in reſpect of diſtention) is leſs different from the lungs of reptiles than it is eaſy for any one bred up in the old doctrines to conceive.

In expiration the lungs do not even collapſe in any ſenſible degree. Let us take for our data the common calculations concerning the quantity of air in the lungs, and let us ſee what they will do towards proving this opinion. The lungs are ſuppoſed to contain

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* Mr. Kite, one of the lateſt writers on the recovery of drowned perſons, has the ſame notion. "We inflate and empty the lungs (ſays he), in order by their expanſion and contraction to FORCE the blood acroſs from the right to the left ſide of the heart."—and he expreſſes himſelf as perfectly indifferent what kind of air be uſed, foul or pure is all one.

at the time of their utmoſt fulneſs about 220 cubic inches of air. When we continue breathing in a natural and eaſy way, we draw in and expel alternately about 40 cubic inches of air; but when we chooſe to force reſpiration, we find that we can expel without danger or harm 70 inches more; we can expel 110 inches of air, leaving only 110 inches remaining in the lungs. Now let us, for a moment, obſerve how little danger or diſtreſs it occaſions when a forced reſpiration is made—ſuch as is uſed in coughing, laughing, ſpeaking, crying, expelling the child, urine, or feces, bracing up the body for the lifting of heavy weights, or other violent occaſions, for which ſuch forced reſpirations are by nature reſerved. Let us notice how much forced reſpiration exceeds the ordinary reſpiration, and how ſmall a proportion the quantity of an ordinary breathing, viz. 40, bears to 220, the whole quantity of air within the lungs. Reflecting thus what large inſpirations of air we may take, and how very little we do take, we begin to perceive how gentle the motion of the lungs muſt be.

There remains always within the lungs a great maſs of air, which I will call the permanent dilatation of the lungs, which, from the firſt movements of the child, from the hour of birth till death, and even after death, muſt remain in the lungs. This maſs, equal to 220, cannot be entirely breathed out; even the utmoſt force of reſpiration expels but the half: this is never done but on extraordinary and moſt urgent occaſions, which do indeed diſturb the circulation; as coughing, laughing, crying, or running do. But this great maſs is ſeldom ſo moved; it is regularly and gently agitated by the change of 40 parts of the 220 which we expire and draw in again at each breath: we do not empty and fill the lungs at each breath; there is, on the contrary, a permanent expanſion of the lungs, and a maſs of air always in them; there is along with this a gentle and regular agitation; and there is changed at each reſpiration a ſmall proportion of this maſs of air. Our lungs are little different (in reſpect of diſtention) from thoſe of Amphibiæ: for their lungs alſo, as I have deſcribed in the Frog, are permanently expanded, and at each reſpiration a little dilated and contracted; the air a little changed, a little moved, a little renewed; the change is in both caſes placid and gentle, and hardly to be perceived.

With theſe opinions concerning the ſtate of our lungs, nothing can appear to me more coarſe than the notion of their being entirely filled and emptied at each breath; nothing more ignorant than the ſuppoſing them to fall flat, as Hales expreſſes it, ſo as to hinder the motion of the blood: and the groſſneſs of this opinion appears in its true light when I put down this laſt proof, viz. that for each act of reſpiration there are four pulſes of the artery, or four ſtrokes of the heart. Is it not plain, then, to the meaneſt apprehenſion, that if the blood moves twice through the lungs in expiration, and twice during inſpiration; or, in other words, if there be four ſtrokes of the artery for each reſpiration, and if each of the four pulſes be equally ſtrong, that the blood paſſes through the lungs in all ſtates and conditions with equal eaſe * ?

It is alſo univerſally believed, and it is indeed a moſt legitimate concluſion, from this doctrine of the collapſe of the lungs hindering the paſſage of the blood, that if but the foramen ovale or any paſſage be left open to let through the blood, that perſon will live without breathing.

It has been affirmed, that the Seal, the Beaver, the Otter, have the foramen ovale open. In the Seal, the Pariſian diſſectors found the oval hole open as in a child; but when they came to the foramen ovale of the Beaver and Otter, they found them, and ſore againſt their will, quite cloſe. In their diſappointment they could have ſaid any thing; but all that they thought prudent to ſay was, that the Beaver had not been in the water for a long while, not even to refreſh himſelf †, and the Otter had been cloſe penned up in his hut at Verſailles; and ſo the foramen ovale had cloſed in theſe poor beaſts quite cloſe; and behold they were no longer Otters and Beavers, but

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* Their old and favourite experiment, ſo often repeated by Hooke, Croone, and others, before our Royal Society, viz. of blowing up the lungs of a Dog, and then compreſſing them, is good for nothing: for there the thorax is cut clean away; the permanent diſtention of the lungs is entirely loſt; and then, no doubt, there is ſuch a collapſe of the lungs, as may, or rather muſt, hinder reſpiration; for the lungs are alternately diſtended to the greateſt degree, and then emptied as completely.

† The Beaver ſits in his hut juſt up to the hips in the water, and builds his hut ſo that he may ſit juſt up to the hips.

little better than dogs*. Although Haller† declares that he had found the foramen ovale open in a man who was hanged; though Rœderer, Cheſſelden, and many creditable witneſſes, have teſtified the ſame; ſtill there has gone along with theſe confuſed doctrines about the foramen ovale a kind of dream (like that concerning the transfuſion of the blood), that if but the foramen ovale could be preſerved open, Man even might be made an amphibious creature. At firſt this notion began to peep through the miſts of this doctrine; and you might find an author, when he had diſſected a perſon with the foramen ovale open, inſinuating by oblique notions, what a vaſt pity it was that the man had not known, during his life, how kind nature had been to him, and what a perfect diver he was! while another ſays plainly, on a like occaſion, "what a pity it was that this child did not live!" we ſhould have ſeen almoſt an amphibious human animal, at leaſt a moſt notable diver‡. On this ſlender ground they told the moſt wonderful tales, among which Pechlinus's ſtory of the Tronningholm gardener is one of the prettieſt. "The ice having broken, the gardener, in trying to help out ſome others, as frequently happens, ſlipt in himſelf into a place full eighteen yards deep. There he no ſooner touched the bottom, than he felt as if you had clapt a plaſter over his mouth; his feet ſtuck faſt, his body became rigid, and he ſtood there as ſtiff as a ſtake, with no one of his ſenſes about him, except only that he thought he heard all the while the Stockholm bells ringing moſt pleaſantly; and there he ſtood for ſixteen hours, the folks ſeeking him up and down, and wondering where he could be: at laſt having found him, they hooked him out with a pole; and after much warming, and rubbing, and working, and giving him hot drinks, they got his blood to circulate, and brought him to life again. He had ſenſe enough, however, he ſaid to feel their hook; and indeed they had angled ſo ill, that his head was all bruiſed, and he had terrible headachs: but, however, the Queen-Mother gave him a good penſion, and he was ſixty-five years of age when Pechlinus wrote.*"

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* "Cette ouverture, qu'on appelle le trou ovalaire dans le fœtus, fait l'anaſtomoſe par le moyen de laquelle le ſang va de la veine cave dans l'aorte ſans paſſer au travers du poumon; et c'eſt apparemment pour une même uſage que ce paſſage ſe trouve dans le veau marin que dans le fœtus, à cauſe du beſoin que l'un et l'autre ont de ſe paſſer de la reſpiration, ſçavoir le veau marin pendant qu'il eſt plongé dans l'eau, et le fœtus pendant qu'il eſt dans le ventre de ſa mere, où il eſt certain que les anaſtomoſes ſervent a décharger le poumon de l'abondance du ſang qui le ſuffoqueroit."—Vid. *Acad. des Sciences*, Anno 1699, page 149.

† Vol. II. Part 2. p. 11.

‡ Mr. Chemineau ſays, "On auroit vue avec étonnement un Homme preſque amphibie comme la Tortuë." Page 38.

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* Hortulanus Tronningholmenſis etiamnum vivens, annos natus 65, pro illa ætate ſatis adhuc valens et vegetus, cum ante 18 annos alii in aquas delapſo opem ferre vellet, forte fortuna et ipſe per glaciem incautius procedens, aquas incidit 18 ulnas profundas: *ubi ille, corpore erecto quaſi ad perpendiculum, pedibus fundo adheſit.* Conſtitit ſic per 16 horas, antequam produceretur in auras. Dixit autem, ſimul ac infra aquarum ſuperficiem fuit demerſus, *ſtatim obriguiſſe totum*, et, ſi quem tum habuit motum et ſeuſum,

amiſiſſe

This is one of the many ſtories of men preſerved by the foramen ovale not having been ſhut. At firſt, I ſay, this opinion began to peep out in hints and reflections; then it ſtrengthened into wonderful tales of people being recovered who had been under the water ſix days; till at laſt a great genius undertook t[illegible] make water-whelps upon a new principle, viz. wi[illegible]h the foramen ovale open. This great genius was th[illegible]e Count de Buffon. Indeed even this very year a ver[illegible]y celebrated author, Dr. Beddoes, forgetting, perhap[illegible], how ſucceſsful Buffon is, tells us (page 41), that "b[illegible]y frequent immerſion in water the aſſociation betwi[illegible]t the heart and lungs might perhaps be diſſolved, an[illegible]d

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amiſiſſe niſi quod ſonantes Stockholmii campanas etiam ſub aquis ob[illegible]b-ſcurius percipere ſibi ſit viſus. *Senſit etiam, ſtatim ſeſe velut veſiculas[illegible] ori applicaſſe*, adeo ut aqua nulla os penetraverit, in aures ver[illegible]o tranſitum, etiam ſentiente illo, habuerit; atque inde auditum ſuu[illegible]m debilitatum aliquandiu eſſe. Hoc ſtatum dum 16 horas perman[illegible]t fruſtra quæſitus, tandem repertum, conto in capit infixo, cujus etia[illegible] ſenſum ſe habuiſſe dixit, fundo extraxerunt, ſperantes ex more a[illegible]t perſuaſione gentis revicturum eſſe. Itaque pannis linteiſque produc[illegible]tum obvolvunt, ne aer admitti poſſit pernicioſus futurus ſubito il[illegible]lapſu! Cuſtoditum ſic ſatis ab aëre ſenſim ſenſimque tepidiore loco[illegible] admovent mox calidis adoriuntur faſciis, fricant, radunt, et ſufflaminatum tot horis ſanguinis corporiſque motum negotioſa illa opera reducunt: denique antapoplecticis et genialibus liquoribus vitæ reddunt et priſtinæ mobilitati. Retulit is atque oſtendit ſe etiamnum in capite circumferre veſtigia violentiæ a conto illatæ et cephalalgiis vexari graviſſimis. Et propter hunc ipſum caſum, religioſe a popularibus, et hujuſce rei teſtibus probatum, Sereniſſimæ Reginæ Matris munificentia et annuo ſtipendio eſt donatus."

an animal be inured to live commodiouſly under water for any time."

Let us move juſt a ſtep backwards in this new trade of making amphibious animals, and obſerve how the celebrated Buffon ſucceeded. "I procured a pregnant bitch (ſays Buffon) of the large greyhound kind; and when juſt about to litter, I fixed her ſo in a bucket full of warm water, that her hinder parts were entirely covered. In this ſituation ſhe brought forth three puppies; which, after being diſengaged from their membranes, were immerſed in a fluid nearly of an equal temperature with that of the amnios. After aſſiſting the mother, and waſhing the puppies in this water, I ſuddenly removed them into a pale of warm milk, without allowing them time to reſpire. I put them into the milk in preference to the water, that they might have an opportunity of taking ſome food, if they found a deſire for it. I kept them immerſed in the milk for more than half an hour; and when taken out of it, all the three were alive. They began to breathe, and they diſcharged a quantity of fluid matter by the mouth. I allowed them to reſpire about half an hour, and again immerſed them in the warm milk, where they remained another half hour. I then took them out; two of them were ſtill vigorous, but the third ſeemed to languiſh: I therefore ordered it to be carried to the mother; which, beſides the three brought forth in the water, had littered other ſix in the natural manner. The puppy which was born in the water and had continued one half hour in warm milk before it was allowed to breathe, and another half hour after it had reſpired, ſeemed to be very little incommoded; for it ſoon recovered, and was as active and lively as thoſe which had received no injury. Of the ſix that were brought forth in the air, I threw away four; ſo that there remained only two with the mother, beſides the one that had been littered in the water. I continued my experiments upon the other two which had been twice immerſed in the milk: After allowing them to breathe about half an hour, I plunged them a third time into the milk, where they remained another half hour. Whether they ſwallowed any of the milk, I could not determine; but when removed, they appeared to be nearly as vigorous as before their immerſion." "I puſhed theſe trials no farther: but I learned enough to convince me, that reſpiration is not ſo indiſpenſibly neceſſary to the exiſtence of a new born animal as to an adult; and that by employing certain precautions, it is, perhaps, poſſible to keep the foramen ovale open; and, by this means, produce excellent divers, or a ſpecies of amphibious animals, which would be able to live equally in air or in water."

I am ſorry to ſay that I cannot pay Mr. Buffon the compliment of thinking that he was deceived in ſo ſimple an affair as this; yet he certainly could not ſucceed. I leave it with my reader to judge what ſhall be ſaid of Mr. Buffon; for it was not the foramen ovale that he was to keep open, if he wanted to make Amphibiæ; but, ſince the function of the placenta was juſt cut off in theſe whelps, and ſince he did not allow them the office of the lungs, he was to ſeek for ſome other third function, which could ſtand in place of the functions of the placenta and lungs; and ſince no ſuch function has yet been obſerved, I judge from all the principles which I have laid down, that Mr. Buffon was telling a vain-glorious idle tale; that he was conſcious that he had ſucceeded in no degree; and that he could no more have converted them into amphibious animals, than he could have made them what they were, viz. plain whelps. "Sed quis fallat omniſciam, ut ſic loquar, naturem? Illa non colludit noſtris erroribus, et quod ignorantia celaverat ſuo detegit tempore."

CHAP. V.

OF MALCONFORMATIONS OF THE HEART, AND OTHER CAUSES, PREVENTING THE DUE OXYDATION OF THE BLOOD.

WE are at no period of life, from the cradle to the grave, exempted from thoſe diſeaſes which prevent the due oxydation of the blood. They often are born with us; they often overtake us when advanced in life; they cauſe an anxiety and miſery, which exceeds all other diſtreſs: pain and ſuffering of every other kind humanity can bear, but the feeling of inſtant diſſolution is what the nobleſt mind ſinks under. We know by the pale and ſubſiding countenance how awful the inward feelings are, and woe be to him who has not feeling enough to ſympathiſe with this diſtreſs, and an anxious deſire to underſtand the cauſe, and to alleviate the miſery, of inward diſeaſes which he cannot cure!

Theſe are ſeducing motives, and might of themſelves have drawn me on to give this ſlight ſketch of the malconformations and diſeaſes of the heart: but I feel alſo the ſtronger motives of duty and neceſſity; for truly, without ſome knowledge of the ill organized, irregular, and diſeaſed heart, the ſtructure and functions of the heart in its ſounder ſtate would be but poorly underſtood. This ſketch, then, is the laſt part of this anatomy of the heart.

While the following hiſtory ſerves to correct our notions of the mechaniſm of the heart, we muſt alſo obſerve how it explains and illuſtrates up to a much higher point the combined functions of the heart and lungs, viz. the oxydation of the blood. Perhaps nothing can better explain the effects of a full and healthy oxydation, than a ſparing oxydation of the blood, ſuch as produces diſeaſe.

The fœtus alone can live with its ſingle heart; it lives in the womb by its having a heart different from that of an adult. A fœtus, then, being born, cannot live with that heart which ſerved it in the womb; and Nature, as I have explained already, divides the ſingle heart, and there is then a heart for the lungs and a heart for the body. But if any fault in the organization prevent this ſeparation of the heart; if the foramen ovale be preſerved open; or if there ſhould be any hole in the ſeptum betwixt the ventricles of the heart; if the pulmonic artery do not admit the blood, now that the child is born, and ſhould breathe the air; if the aorta ariſe from the right ventricle, ſo as to carry off all the blood from the lungs; or if the aorta be ſo diſplaced, that its mouth ſtands in part over both ventricles, ſo as to receive the blood of both—then the organization, movements, functions of the heart, are all wrong; no blood paſſes into the lungs, the child cannot live; it either dies immediately in convulſive ſtruggles, or lives in miſery but a few years.

It is not in this rapid enumeration that theſe varieties of malconformation can be underſtood, nor yet do they deſerve to be minutely detailed. I ſhall keep the middle path; and thoſe of my readers will eaſily follow me who have ſtudied the mechaniſm of the heart; concerning which this ſubject will recal to their memory all the important facts.

The moſt uſual of all theſe diſorders of the heart is ſome fault in the pulmonic artery; and that diſorder again is fruitful of others: for if the pulmonic artery cannot receive its blood, the foramen ovale cannot cloſe; then the blood cannot circulate nor paſs into the lungs when they firſt expand; then the office of the right heart is taken away, it has no power but to drive the blood with ſtruggles through the foramen ovale into the left heart; the left heart then drives this blood, unoxydated as it is, into the aorta: the heart is now a ſingle heart; it is the left heart alone that receives or circulates the blood: either it labours but for a few pulſes, and then the child, after a convulſive vulſiue ſtruggle, expires; or there is ſome degree of opening in the pulmonic artery, a little blood paſſes through it into the lungs; the child is by that enabled to ſtruggle with its convulſive pangs for eight or ten days, and then expires.

Such a ſcene the celebrated Dr. Hunter once witneſſed; and there was, I perceive, in that heart a peculiarity very much to be admired. The chief fault was in the pulmonic artery, which was contracted into a ſolid ſubſtance or cord abſolutely and completely impervious, ſo that the lungs had never received one drop of blood by the pulmonic artery. And here I muſt ſtop to notice one thing which I have always ſuſpected, and which this diſſection proves, viz. that though it is natural to believe, and the beſt phyſiologiſts ſuppoſe it, that ſome blood, as much at leaſt as to ſupport the form of the pulmonic veſſels, paſſes through the fœtal lungs; yet here is direct proof that a well nouriſhed child may be born capable of breathing, and in which the pulmonic veſſels are all free except at the heart, in which not one drop of blood ever has paſſed into the lungs. But chiefly it is to be obſerved, that this child, with its pulmonic artery quite impervious, could not have ſtruggled a ſingle day, far leſs ten days, without ſome proportion of oxydated blood! and accordingly we find that it had a ſmall portion, juſt ſuch as ſupported life for a few days; which ſmall proportion it obtained thus: The blood went to be oxydated, not from the right ventricle into the pulmonic artery, but from the left ventricle into the aorta; from thence into the ductus arterioſus;

and then, by a retrogade courſe, backwards through the lungs; and then by the pulmonic veins it was returned oxydated into the left ſide of the heart, from whence it came. This child accordingly lived a few days, and could not live longer; becauſe this difficult circulation was continually accumulating a quantity of black blood in the right ſide of the heart.

This child, then, had a heart reſembling that of the Newt or Frog; for the pulmonic artery was cloſed, and the right heart of no value; the left heart puſhed its blood into the aorta, and the aorta, as we may expreſs it, ſent a ſide branch into the lungs. In this firſt inſtance, then, of malconformation, the child could not live, becauſe it wanted the pulmonary artery, and of courſe the office of the right ventricle: it had but a ſingle heart.

Next to this diſorder of the pulmonic artery, viz. being obliterated or being cloſed, is this: That the aorta, in place of ariſing diſtinctly either from the right or from the left ventricle, is ſo placed, that its root ſtands directly over the ſeptum ventriculorum, or partition of the ventricles; that the partition is perforated with a large hole, opening a very free paſſage from ſide to ſide; and that the heart being cut up, we find, upon thruſting down the finger into the aorta, that it paſſes with equal eaſe into the right or into the left ſide of the heart—All which we are the leſs ſurpriſed at, when we remember that in the Chick in ovo, the parts of the heart are all ſeparate pieces, which are joined one to another; and that in the fœtus of other creatures, in the Frog for example, the auricle, ventricle, and artery, are firſt ſeen at a diſtance from each other, and then joined *.

In this conformation of the heart, the ſingle heart appears again in a new form, and the office of the right or pulmonic ſide of the heart is well nigh annihilated. Firſt, The pulmonic artery is ſmall, ſometimes almoſt cloſe: Secondly, The aorta, ariſing as well from the right as from the left ventricle, carries off one half of that blood which ſhould be circulated through the lungs: And, laſtly, That blood, ſmall as it is in quantity, which has paſſed through the lungs, is brought round to the left ſide of the heart; but the left ſide is not as it ſhould be, cloſe, to keep this purer blood for the circulation of the body, but it is mixed with the blood of the right ſide, through the perforated ſeptum, ſo that its virtues, as oxydated blood, are diluted or almoſt loſt.

If the pulmonic artery were unaffected, and the aorta placed equally over both ventricles, then the one half exactly of that blood which ſhould be oxydated would undergo the change. But in all theſe malconformations, the root of the pulmonic artery alſo is in fault; it is narrow; it is ſo ſmall, that at firſt opening ſuch a body it alone attracts the eye; its

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* I do not mean to argue, that when we firſt ſee them, they are ſo little connected, that one could be awkwardly joined to the other, nor that they have no real connection, becauſe it appears as if they had not; but merely this, that as they ſeem, like the parts of the eye, to be organized in ſeparate pieces, I ſhould ſooner expect an unnatural diſplacement of the veſſels of the heart than in the middle of the femoral artery.

mouth is ſometimes ſo beſet with a ſort of fleſhy granulous papillæ, that there is hardly left opening enough to paſs a ſilver probe. The degree of contraction in the pulmonic artery is the true meaſure of all the oxydated blood which that ſyſtem can receive; but in ſuch a ſyſtem the quantity is ſtill farther reduced by various accidents of the organization. Thus, for example,—The pulmonic artery is, we ſhall ſuppoſe, but one third of its natural ſize, and the original quantity of oxydated blood is proportionably ſmall;—next, the foramen ovale, being open, carries off much blood towards the left auricle; the aorta, planted over the right ventricle, carries off alſo much blood.—But let us ſuppoſe, that ſtill as much remains as to fill the pulmonic artery to its full; when the pure blood comes round to the left ſide, it is mixed through the foramen ovale, and through the breach of the ſeptum, with a quantity of black blood, which is continually accumulating upon it; and the ſmall quantity of oxydated blood is, if I may uſe the expreſſion, drowned in the general maſs.

That I may explain the point of its accumulating a little farther, let me repeat, that even in a child which has died on the tenth day of ſuch a diſorder, the heart is crammed with dark-coloured blood: That in thoſe children which have lived two or three years under ſuch a diſtreſs, the heart has been greatly enlarged: That in a boy diſſected by Sandifort, who died at fifteen, the thing that was firſt ſeen upon opening the body was, not the lungs covering the heart and lapping over it, but a large maſs, lying betwixt the lungs, oppreſſing them, and puſhing them aſide in every direction. This was the pericardium covering a heart of enormous ſize, filling the thorax, and reaching almoſt to the firſt rib; very little of the right lobe of the lungs, and none almoſt of the left, was to be ſeen; the veins in the upper part of the thorax, viz. the ſubclavian and jugulars, were choked by the preſſure, and much diſtended; the heart itſelf was full of blood, and the coronary veins ſo turgid, that it reſembled a moſt minute and beautiful injection of the heart.

But it is moſt of all ſingular, that this heart was ſo enlarged, that the great veins (which are indeed as reſervoirs for the right ſide of the heart), and eſpecially the upper cava, dilated along with it in ſuch a degree, that there was felt diſtinctly a pulſation in the neck by a ſort of back ſtroke every time the heart beat.

Still a child, even with a heart ſo ill organized, may ſtruggle through all the weakneſs and all the diſeaſes of childhood* for a few years; but they are years of complete miſery; and ſtill, as is proved by much ſad experience, the boy cannot live, but muſt die.

Another conformation, the ſtrangeſt of all, is that in which new parts are added to the circulating ſyſtem, as if with deſign to make it reſemble the heart of an amphibious creature; for it happens ſometimes, that there is as it were a third heart interpoſed. For example, the two vena cavas end in the right auricle, the pulmonic veins enter into the left auricle and the right and left ventricles receive their blood from their auricles in the uſual way; yet the right ventricle ſends out no pulmonary artery, the left ventricle ſends out no aorta; but both of them pour their blood into a middle ventricle, and the arteries go out from it: and here, as the blood is fairly delivered by both ventricles into this third ventricle, and as the pulmonic artery and aorta both ariſe from it, there is, of courſe, a fair diviſion of the blood; and of the quantity which ſhould be oxydated, exactly one-half undergoes that change. This is ſomewhat like the heart of the Turtle; it is plainly the ſtructure of an amphibious heart, a ſingle heart; for though there be three cavities, yet are they ſingle in their function; it is a ſingle heart with half oxydated blood. Such a heart is ſufficient for Amphibiæ, or for the fœtus, but not for a child, which muſt breathe and have a double heart.

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* Sandifort attended a puer cœruleus, who, in addition to h[illegible] chief diſeaſe, paſſed through the ſmall-pox and meaſles ſafely, an[illegible] attained the age of fifteen.

Theſe are a few of the varieties of the imperfect heart; but the ſufferings of children who are born with theſe imperfections, the marks of imperfect oxydation, and the manner of their life and death, was a chief motive for entering on this ſubject.

When the heart is ſo imperfect that the child lives but a few days, its ſufferings are ſlight, and not lingering, ſo that we cannot mark them: They are not explained to us by any account of its inward feelings: They are all accumulated into one terrible ſtruggle, in which we ſee the worſt marks of ill oxydated blood.

The child is born well and healthy, it cries and draws its breath, it is removed from the mother; the function of the placenta ceaſes, but there is no other to ſucceed it; the child turns black in the face, ſtruggles for breath, and is convulſed; and without any apparent cauſe it ſeems in the agonies of death: But yet it lives, it becomes black all over the body; the blackneſs never goes off except when it changes ſometimes into a deadly aſh colour. The child continues for a few days labouring under almoſt unceaſing convulſions, which, growing gradually weaker, it at laſt expires; and while it lives, the heart palpitates, ſometimes it throbs ſo, that it can be diſtinguiſhed at diſtance by the eye. Dr. Hunter, in the child which I have already mentioned, laid his hand upon the breaſt, and the throbbing which he felt there was terrible to him.

When the child has the heart ſo formed as to admit into the lungs even a very ſmall proportion blood, it ſtruggles through the firſt years of life, and its protracted ſufferings can be more eaſily obſerve Then no mark of ill oxydated blood is wanting; every thing is the reverſe of health, or the natur appearance fluſhed and florid of a growing child; its colour is always dark, its motions languid and powerleſs; it is cold, ſo that the parents muſt keep it carfully wrapped in flannels and furs to preſerve any thing of vital heat; its breathing is difficult and di treſſed; fits come upon it at times; and if the child has begun to walk, the leaſt hurry, or fear, or quic ſtep, even walking acroſs the room, brings a return the fit: in which the extremities are deadly cold, the face black, the breathing one continued ſtruggle, an the end of the fit is the obtaining of a degree of relief, which happens in a moſt ſingular way.

The coldneſs, the livor, the languor, the fainting, the ſtruggles for free breathing, are all marks of ill oxydated blood. The convulſive paroxyſm is a ſure conſequence of the want of ſtimulus and force, and of blood accumulating at the right ſide of the heart. If, then, the child fall down in this paroxyſm, it is the very ſureſt proof that ordinary reſpiration will not ſave him from the ſtruggle; if during the fit he breathe ſo that he recovers, and that preſently his ſtrength, colour, ſpirits, every thing, is in a degree reſtored; then is it plain that the reſpiration during the fit, imperfect as it appears to us, is really more effectual than ordinary reſpiration.

When we obſerve which is the moſt natural way of obtaining relief, and notice the very peculiar manner in which theſe children breathe, we ſhall underſtand why they are breathing beſt when we believe they are hardly getting breath, and how they are recovering ſlowly when we think them labouring in the greateſt danger. The child feeling the growing oppreſſion at its breaſt, if it be young, ſignifies a deſire to be turned upon its face; if not indulged, it contrives to turn itſelf that way before its hard ſtruggle begins. When the child begins to breathe hard, it drives out the air with a ſudden exertion, and apparent pain; he remains longer without reſpiration than an adult could do; his expirations are attended with a ſort of ſcream. What can this way of breathing mean? To my apprehenſion it implies that kind of breathing which I have called forced reſpiration, and no other plainly can ſerve.

The ordinary reſpiration, by which we draw in 40 cubic ounces of air, has failed; the fit is approaching, becauſe that quantity of air will not ſuffice. However rapidly the child breathes, however rapidly the heart palpitates, it will not do, becauſe there are but 40 ounces of pure air mixed with the whole of that great maſs which remains always in the lungs. Then the child, driven by inſtinct, provides for the fulleſt reſpiration: it turns upon its face, that the weight may help to compreſs the thorax; it forces with all its power, and ſeems to ceaſe from breathing, and refrains a long while in that ſtate, becauſe it is emptying and compreſſing the lungs. Then its purpoſe is accompliſhed the lungs are more emptied than in ordinary reſpiration it draws in the largeſt draught of air, utters a ſort of ſcream, ſeems quiet again; and again, by preſſing its breaſt, and by contortions (convulſive-like of its body), it empties its lungs at a diſtant interval, and receives again the fulleſt draught of air. It is this forced reſpiration that brings into the lungs 70 cubic inches of air more than the uſual reſpiration does. This, then, is three times more effectual than ordinary breathing; and when a boy grown up to thoſe years in which he knows the warnings of his diſorder, and has found out this relief; when ſuch a boy by preſſing upon the corner of a table, or by throwing himſelf upon the ground, prevents or alleviates his paroxyſms, in what way can it be but by practiſing for a time this deeper reſpiration? preſſing the cheſt, forcing and compreſſing the lungs beyond their uſual degree of collapſe, and ſo obtaining a fuller draught, a draught of 110 ounces of air, to be mixed with the 110 ounces which muſt always remain in the lungs?

After half an hour of a kind of breathing, moſt awful to behold, but much more effectual than common breathing, the child recovers ſlowly. The boy, when advanced a few years, knows how to prevent the fit; but the child of two or three years old knows only how to ſtruggle with it: yet this ſtruggle being a more effectual breathing, the child is relieved at once from an anxiety, and oppreſſion, and throbbing, which precedes the fit for many days; the languor goes off, the heat in ſome degree returns, and the lips acquire a vermilion colour and the ſkin a higher tint, which laſt for many hours after the fit is gone.

In thoſe children, again, which have the heart ſo formed that they may live not two or three years only, but to the age of 15 years, it naturally happens that the ſymptoms follow each other in their courſe very ſlowly; and the ill oxydation of the blood in this its ſlower progreſs it is very curious to obſerve.

There is one thing in the economy of the fœtus very ſingular, viz. that while it is receiving much oxydated blood from the mother, but a ſmall portion goes through the ductus venoſus directly to the heart, much of it circulates through the liver, and is ſpoiled (we muſt ſuppoſe). What then can this mean? Surely the child, the chick, the fœtus of every kind, needs leſs of this principle of oxygene: the fœtus lives (if this be ſo) like an amphibious creature; perhaps it has little oxydated blood; yet being totally deprived of that little, it ſoon dies. Perhaps the fœtus, living the life of an amphibious creature, does not want alſo that peculiar tenacity of life which characteriſes that claſs; for the ſtruggles and ſufferings which a weakly infant indures, before it parts with life, are matter of obſervation even among the vulgar. For this reaſon I believe it is that children, having a heart ſo ill arranged that abſolutely they cannot live beyond the years of puberty, yet during the firſt years feel no complaint, and ſeem thriving and healthy; the vegetating life of a ſucking child ſaves it from all dangers of hurried reſpiration and rapid pulſe.—But when it leaves the breaſt; when it begins to ſtir and move; when its blood, moving languidly, begins ſlowly to accumulate at its heart; when the properties of its living fibres change, ſo as to require a fuller ſupply of oxygene from the blood—then the ill colour, languor, palpitations, ſlighter fits, and all the marks of its diſeaſe, begin; and often its colour gradually changes, and it becomes the puer cœruleus, or livid child, before we can perceive by any other marks how dangerous a condition it is in.

In one child* the firſt year had elapſed before the very ſlighteſt of thoſe complaints came on, which ended in death at a very diſtant period of 15 years. At firſt its finger nails were obſerved to be livid, yet not continually; the colour varied, but ſtill the nails were unnaturally livid, ſo as to alarm and ſurpriſe the parents; but there was as yet no reaſon to deſire advice. The child ſeemed healthy, began to uſe its legs, and in the ſecond year it walked alone.—Next it happened, that one day after being forced to take a medicine, not without ſome reſiſtance, his face

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[*] Vide Sandifort.

was on the following day freckled with red ſpots, which ſoon changed to a livid hue. Now the laſſitude and chillneſs came on; motion or exerciſe were more and more oppreſſive to the boy; till at laſt when he fatigued or hurried himſelf, the hands and feet became livid, the mouth and tongue became almoſt black, and laſt of all thoſe fits came on in which the whole body becomes livid or black.

This is the progreſs of this darker colour of the body; but his other complaints alſo advanced with a very ſlow and regular pace. He increaſed in ſtature, his appetite was good, he complained of great laſſitude, of headach, with a ſort of gravitating pain, of anxieties, eſpecially during the winter months, and of ſuch extreme coldneſs, that neither fire in winter nor ſummer's ſun could warm him; he never felt heat except when juſt wrapped up and newly laid in bed.

Now the blood began to accumulate; the ſtruggles of the heart began; and ſo terrible were the throbbings of his heart at times, that they might be ſeen or even heard. Actual faintings ſucceeded; the poor boy, now eleven years of age, knew that he was to die; he ſaid, that "no one could know or cure his illneſs, and that no one could imagine what feelings he had here at his heart."

Motion was now quite impoſſible; upon the ſlighteſt effort ſaliva flowed from his mouth, a fainting fit enſued, and he continued for a little while blind. All that he was wont to delight in was now indifferent to him; he could not move; his face was turgid, his eyes prominent, his feet were ſwelled with an œdema, his eyes dead and heavy, expreſſive of ſome inward diſtreſs; when he was put to bed his anxieties were very great, and thus he died a ſlow and miſerable death.

Sometimes a child wants ſpirit or ſtrength to ſtrive againſt the laſſitude of this diſeaſe. A girl under Vaſalva's care lived to her fifteenth year; but from her infancy, from her very birth, ſhe had lain in bed, partly on account of ſickneſs, but chiefly on account of extreme weakneſs. She had a ſhort and difficult breathing, and her ſkin was tinged all over with a livid colour; her quiet ſtate ſaved her from the ſuffocating paroxyiſms; but her heart was juſt like all the others, the foramen ovale open, and the pulmonic artery cloſed.

Theſe, then, are the marks of ill-oxydated blood: a livid colour, coldneſs which nothing can remove, oppreſſion and anxiety of the breaſt, palpitations and difficult breathing; and when the blood is by paſſion or motion hurried too faſt towards the right ſide of the heart, then come fits, which laſt a longer or ſhorter time in proportion as they have been long delayed, and which end in death. And laſt of all, I would rank among theſe conſequences an imperfect nouriſhment, for all the boys have been ſmall, moſt of them particularly ſlender; and one boy eſpecially, of fifteen years of age, is mentioned by Hunter, who, in reſpect of tallneſs, was juſt what you ſhould expect at his years, but ſlender to a wonderful degree; not as if waſted by conſumption, but as if by natural habit. His form was quite ſurpriſing, ſo that Hunter could give no idea of his ſhape, otherwiſe than by comparing his body with that of a Greyhound; and his egs, he ſays, put him in mind of thoſe of a Crane, or ſome tall water-fowl.

The conſequences muſt be alike, whether it be that the heart ſends no blood towards the lungs, or that the lungs cannot receive that blood; and the malconformations of the heart are hardly more frequent than thoſe of the lungs; and both, we may be well aſſured, are infinitely more frequent than we ſuppoſe; eſpecially when we obſerve how many children die ſuddenly, diſcoloured, and in convulſions; and how many of thoſe advanced in years have lived very miſerable with complaints in the breaſt.

A young man of twenty-four years of age, by birth a Pole, and at the time of his death a ſoldier in the German ſervice, had been continually oppreſſed from his cradle upwards with difficult breathing and anxieties at his breaſt. He had been three or four times relieved from ſlighter complaints of the breaſt; but at laſt the bleedings and demulcent medicines failed: he lay ill in the military hoſpital two months, where of courſe his complaints were correctly known. He had none but the ſlighter degrees of difficult breathing; when one day ſitting up in bed he ſuddenly expired. Being opened, the right ſide of the lungs was found to be totally wanting; not deſtroyed by diſeaſe, as we have often ſeen, not oppreſſed by water nor eroded by pus, but entirely wanting; a peculiarity which he had from his mother's womb, for it was attended with a peculiar arrangement of the veſſels. On the right ſide there was no veſtige of the lungs, not even the ſmalleſt button to mark where they might have been; there was no branch of the trachea for the right lobe intended by Nature, but both the legs of the trachea plunged into the left lung, which was large: There was no forking of the pulmonary artery to give a branch to the right ſide, but the whole trunk of the pulmonic artery plunged into the left lung.

But if one ſhould ſuſpect that there might have been once a right branch, the lungs deſtroyed, and the mouths curiouſly united by that mucus which the membranes of the viſcera, and the pleura eſpecially, throw out when inflamed; there are ſtill other caſes which muſt remove all our doubts, eſpecially that of a young man *, who died in a very lingering way, and in whom before his death there was plainly perceived, along with his ſlight anxieties, a pulſation in the right ſide of the breaſt. Upon opening his body, there was found in the left ſide neither lungs nor heart; nor, upon the moſt careful examination (ſeeking for the waſted lung), could there be found the ſmalleſt remains of lungs, bronchiæ, pulmonic arteries, or the ſlighteſt evidence that any ſuch parts had ever been. But the ſureſt proof of this remains behind, for the heart ſtood in the right ſide of the cheſt; it ſtood perpendicularly, quite upright like a Dog's; it gave out a right pulmonic artery, but there was not even the ſmalleſt veſtige of any artery having been appointed for the left lobe. We muſt not ſay, yet his cheſt may have been full enough of lungs and heart, and he may have had a well-oxydated blood; in which caſe it was

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* Under the care of Dr. Heberlen. Vid. *Acta Vendobonenſis.*

no very dangerous derangement that his lungs were all on the right ſide, more than if his liver had been on the left. But let us notice that the aorta was extremely ſmall; the diameter of the aorta is the true meaſure of the blood which is received from the lungs. Where the aorta is ſmall, ſurely the lungs are not good, nor the ſyſtem fully ſupplied with oxydated blood.

We alſo know that though the veſſels of the lungs themſelves may be natural and well arranged, the lungs may ſtill be amiſs; they may want the proper ſtructure of cells in which the blood ſhould be expoſed; they may be encumbered with tumours ariſing out of their ſubſtance, by which they will be prevented from dilating. One is pleaſed to find in old authors good deſcriptions of diſeaſes which have remained for ages unknown; and among theſe I reckon that of the celebrated Spindler, whoſe deſcription I admire as much as that of any ſucceeding author.

The child of a certain prince having died after a few days of great ſuffering, Spindler opened the body, and found all ſound and right, except that there were ſeated upon the two lungs two tubercles of a variegated red colour, as were the lungs themſelves; which tumours, no doubt, hindered the paſſage of the blood, which he expreſſes with a correctneſs in reſpect of phyſiology quite unknown in thoſe times. "Quæ vomicæ procul dubio hujus aſphyxiæ cauſæ extitere denegata circulatione ex dextro in ſiniſtrum cordis ventriculum." His deſcription of the diſeaſe ſo long before it was properly underſtood is curious: "During the eight days in which the child lived, it had never cried ſtrongly nor clearly, had never ſucked, had never been regular in its bowels, breathed as if its ſides had been blown up; it was ſuddenly ſeized with a fit, which ſeemed epileptic, ſoon went off, but ſoon returned; the whole face and body became firſt red, then of a copper colour; the breathing was interrupted, the eyes immoveable, the feet and hands lay almoſt lifeleſs; it ſuffered at leaſt a hundred of theſe fits before it expired."

To enumerate thoſe caſes where a defect of the lungs were the conſequence, not of malconformation, but of diſeaſe, were a buſineſs quite inconſiſtent with my deſign; yet I wiſh to record theſe two.—Firſt, It has been long obſerved, that by long continued ſuppuration, the lungs are often ſo waſted that not a bud or particle of them remains: ſometimes theſe patients ſurvive, dragging on a languid and miſerable exiſtence, enjoying no freedom, life, nor ſpirits; and the cauſe of their frequent ailments is diſcovered at their death. The lungs alſo may be thus compreſſed even by the mere preſſure of water within the cheſt, which has cauſed ſuch a ſubſiding, or rather abſorption, of the lungs, without any ulcer of their ſurface, that one lung has been oppreſſed till it became no more than three lines in thickneſs; and indeed it was not eaſily found: ſo Haller ſays in his Commentary upon Boerhaave. But of all the ſtrange things which Haller or any man has ever related, what he tells in the following words is the moſt incredible; at leaſt it is ſo improbable as to be incredible. " A man having died of a lingering diſeaſe occaſioned by a fall, the left lobe of the lungs was not to be found; that ſide of the cheſt was full of a coagulable ſerum; but the aſpera arteria and large arteries and veins (a thing which I never could have believed, had I not ſeen it myſelf) opened with gaping orifices into the cavity of the thorax, as if they had been cut acroſs; ſo that it was very hard to conceive what had prevented the blood from pouring out." Haller, p. 34.

Secondly, In the peripneumonia notha there is not merely an inflammation of the pleura, as the name expreſſes, but of the lungs themſelves; and it is not from inflammation, pain, fever, or acute ſuffering, that they die; but becauſe the lungs are entirely crammed with blood; the heart can no longer move: they are not ſenſible of their dangerous ſtate, but are ſuffocated in a moment, and die without a groan. It ſeems more frequent in other countries than in this, though no country is exempted. When this diſeaſe comes upon a place, it comes with all the frequency and deſtruction of an epidemic diſeaſe; and the ſudden unexpected deaths are terrible. Vaſalva found an old gentleman going abroad in the morning, and prevented him, queſtioning him about his complaints, which he himſelf thought very ſlight: but Vaſalva gave notice privately to the ſervants to expect nothing better than their maſter's death; and notwithſtanding all aſſiſtance, he was that very evening dead.

The pulſe is weak, the cough ſlight, the difficulty of breathing more anxious than painful; the face ſunk in the features and fluſhed, or rather of a lurid colour, except when it is cadaverous, pale, and ſallow; the ſuffocation is ſudden; the lungs have, as

Morgagni expreſſes it, a liver-like, ſolid conſiſtence; they have no longer the cellular appearance of lungs, for their bronchiæ are crammed with blood; their common cellular texture is alſo full of exuded blood; they are denſe, ſolid, very heavy, and black, and they ſink in water like the lungs of a fœtus. The heart is ſo curbed in its actions, that it gives but a ſmall, feeble, and trembling pulſe; and even in a few days (as in the fœtus having an imperfect organization) the heart is wonderfully dilated and enlarged, and filled with fluid and grumous blood. Haller laments the death of friends by this terrible diſeaſe, and eſpecially of his own ſon, " whoſe body he gave to be opened by thoſe ſkilled in diſſections."

Perhaps the heart may be too ſmall for the ſyſtem to which it belongs; and this, I doubt not, had been the caſe with that boy in whom Kerkringius found it ſo ſmall, that though the boy was nine years old, the heart (*i. e.* the ventricles) was no bigger than that of a fœtus; and the whole heart, auricles, ventricles, and all, was no bigger than that of a child born at the full time. But in proportion as the heart was ſmall the veſſels were large, not at all aneuriſmal, but of ſuch a ſize, and ſcarcely of ſuch a ſize, as might ſuit the heart of a boy of nine years old. This boy had for five years been hectic, that is to ſay, he had been troubled with no formed diſeaſe, but with continual diſtreſs, anxiety, weakneſs, and quick pulſe. This heart was plainly inadequate to the functions of any ſyſtem; but the caſe is too ſlightly ſketched for us to find any decided marks of ill oxydated blood.

But that the heart may be too big for its ſyſtem, is a melancholy fact; for when it becomes relaxed, it enlarges, and as it grows in bulk loſes in power. That the heart is enlarged merely by weakneſs, by ſubmitting to dilatation, by wanting ſufficient power to free itſelf of accumulating blood, is very plain; for in the plague, in low and peſtilential fevers, even in nervous affections, it ſometimes enlarges, and from a temporary becomes a mechanical and fixed diſeaſe. How often do we read in the preface to ſuch diſſections of enlarged heart, " he was of a melancholy temperament, of a ſlow and ſedentary life, oppreſſed by misfortunes, and ſtruggling with vexations and grief." In the angina pectoris, which is in its firſt attack no organic diſeaſe, we often find the dilated heart pale and tender, ſo that the fingers may be puſhed through its fleſh.

While the heart gradually enlarges, the ſyſtem changes, and accommodates itſelf to its powers. There is little diſtreſs; often we find a heart enlarged to a degree ſuch as we never could have ſuſpected before death. But ſlowly there is formed ſuch an accumulation of ill oxydated blood as oppreſſes the vital powers, and chokes the motions of the heart, and draws after it thoſe other diſorders which are already in part explained.

Of the mechanical conſequences which follow the enlarged heart, thoſe chiefly attract our attention which prevent the due oxydation of the blood.

Firſt, The dilatation of the heart draws after it a dilatation of the great veins, ſo that they become reſervoirs as it were; and the auricle and veins both enlarge ſo, that the office of the auricular valves is quite loſt; the veins feel, or rather the column of blood in the veins feels the back ſtroke from the heart, and it is perceived even in the neck by a ſtrong pulſation.—Secondly, Theſe veins, and this monſtrous heart, ſo fill the cheſt, prevent the blood of the neck deſcending, and ſo puſh aſide the lungs, as to compreſs them to the laſt degree that is conſiſtent with life.—Thirdly, The enlarged heart accumulates much blood in the ſyſtem which before did not exiſt, and that blood dark coloured and unfit for the purpoſes of life. The proportion betwixt the great maſs of ill oxydated blood lingering in the veins and about the heart, is increaſed ſo very greatly, in oppoſition to the very ſmall quantity which can now be oxydated in the lungs, that ſuch perſons are expoſed every moment to the greateſt dangers; and the leaſt accident which draws out more black blood from the veins, and hurries it towards the heart, quite overcomes them. Then there is an agonizing and fearful ſtruggle; the heart often ſtruggles, and often frees itſelf; but in moſt caſes thoſe who live in this condition do, after many eſcapes, fall down ſuddenly dead. "A very learned man having this enlargement of the heart while he was ſtill walking about in his ordinary health, his heart would often ſtop for three or four pulſations, as if ſtruggling with its load, velutque expulſionem moliretur *."—Fourthly, In this enlargement of the heart, although ſometimes there is a perfect and equal pulſe, though ſometimes alſo the diſeaſe ſcarcely ſhows itſelf till very far

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* Veſalii, lib. i. cap. v.

advanced, and after many years of ſlow increaſe; yet the heart being continually loaded, and often ſtruggling, cannot free itſelf at one ſtroke of all its blood; then, ſtroke ſucceeding ſtroke in a confuſed irregular way, there is a weak, irregular, intermitting, fluttering pulſe.—Fifthly, But Nature, wonderful in her ways, ſometimes finds relief from this in the regular conſtitution of theſe parts; for while the heart dilates, and becomes more powerleſs as it dilates, the aorta (being but poorly filled) contracts in proportion as the heart dilates, and accommodates itſelf to the ſmall quantity of blood which ſuch a heart can give out; and thence the wonder ſometimes expreſſed at finding an aorta extremely ſlender joined often to an enormous heart.

"In opening the body of a ſhoemaker, ſays Morgagni, whoſe heart was wonderfully enlarged, ſeeming as if you had joined two hearts, what chiefly ſtruck us was the ſmallneſs of the aorta, more ſuitable to a delicate woman than to a man of good ſtature as this was. The aorta, from its paſſing under the diaphragm to its great diviſion in the pelvis, was very ſmall. This Morgagni firſt of all believed was owing to ſome ſtricture at the diaphragm; for the aorta did not paſs as uſual under the legs of the diaphragm, it paſſed through a peculiar hole; but he found this tendinous hole quite large and free. Still he believed that all the diſorder of the heart aroſe from the contraction of the aorta, and that again from the crooked poſture in which thoſe ſit who are of this trade. But that often the artery is contracted in favour of the enlarged ventricle, I am able to prove better than by this caſe of Morgagni's.

gagni's. In the firſt place, the diſtorted poſture of his ſhoemaker can have no effect; for we muſt not forget how limber, flexible, and free from diſeaſe, the aorta is in thoſe who have the unhappineſs to be deformed, and in whom the aorta follows the ſpine ſo cloſely, that often the bones almoſt meet in their diſtortions, and hide it. I have cut out theſe aortas ſometimes and laid them on boards, to ſhow the ſtrange angles which they make with ſuch perfect ſafety. Next I have to obſerve, that where the auricles and ventricles dilate in old people, the aorta alſo dilates: for there the aorta is old, partly oſſified; its muſcular coat ſtiff and incapable of action; it is, in ſhort, as weak as the heart itſelf, and yields along with it to the accumulating blood. But in younger men, the aorta being muſcular and ſtrongly contractile, this phenomenon enſues: that as the heart increaſes in ſize and weakneſs every day, it ſtruggles with leſs effect againſt the accumulation; its pulſes are imperfect; it delivers leſs blood into the aorta; the aorta, leſs perfectly filled, is not excited by the ſame power which formerly filled it and kept it full: therefore it contracts gradually and ſlowly; it preſerves ſtill its healthy conſtitution; it is limber, pliant, and ſound, in its muſcular coat. In ſhort, this doctrine of Morgagni's implies only a ſtationary condition of the aorta; this other theory implies an active contraction. Now Morgagni's ſhoemaker was a portly man, but his aorta was ſmaller than a woman's. Even this caſe of his own implies an actual contraction; ſince, had this man's aorta continued ſtationary, it muſt have been ſtill the aorta of a man of good ſtature, joined to a large heart. But a perfect proof is this: I have a heart which it would not be eaſy to deſcribe; it is not only as big as two hearts joined, but I may ſay, with Bartholine, "ut ſæpe in Bobus non magis ſit aut ponderoſior." The heart is bigger actually than an ox's; it is bigger, I think, by the whole ſize of its two great auricles; it is injected with wax; it weighs more than four pounds, and is two feet in circumference; but the aorta is no bigger than the femoral artery at the groin, very ſtraight and even in its diameter, very ſlender, and with coats which plainly have been very thin and ſuitable to ſuch an artery. Here the artery is equably and fairly contracted to one fourth of its natural ſize, which ſuppoſes a natural and ſound condition of its coats: And one of two things muſt have happened, either the artery muſt have contracted firſt, oppoſing the heart and cauſing it to enlarge; but then its violent contraction, like the urethra contracting in oppoſition to the bladder, would have thickened it into a ſtrong muſcular tube: or, ſecondly, the artery muſt have contracted gently and gradually in favour of the dilatation and weakneſs of the heart; and then it would remain (as this artery really was) very ſoft, delicate, and limber; in ſhort quite natural. I ſuſpect alſo, that where the aorta is enlarged, there is required a ſtrong, ſmall, and muſcular heart; becauſe I have an aorta enlarged to a very great degree, the heart being extremely ſmall. Theſe accidents will be noticed chiefly where, in young people, there happens ſuch diſproportion of muſcular power betwixt the heart and its veſſels; but in the aged, all the parts are but too much diſpoſed to diſeaſe, and the whole will enlarge.

Theſe, then, are the chief conſequences of that enlargement of the heart which often ſo fills the thorax and loads the diaphragm, that it falls down under the weight of the heart: then the heart is felt lower than natural; and the diſorder is named by moſt authors the prolapſus cordis. In a young man of twenty years of age, the moſt miſerable creature I ever ſaw, I have felt a prodigious heart beating as if quite in the abdomen: at the pit of the ſtomach the pulſation was particularly ſtrong; it muſt have been miſtaken for an aneuriſm of the cœliac artery, had not the heart been felt beating from the navel almoſt to the collar-bone.

Whether we are to allow, that the blood ſometimes does coagulate and form polypi in thoſe enlarged hearts, I believe no man in the preſent ſtate of our knowledge will venture to decide. That the blood ſhould coagulate thus firmly, while within the body, and that not in a corner of the circulating ſyſtem, but in the heart itſelf, where always there muſt be ſome motion, it is not eaſy to believe; nor that ſuch coagulations ſhould remain there, be waſhed pure by the current of blood, ſo as to have a leathery colour, and to be firm and ſtrong; that ſuch coagula ſhould entangle the valves and columnæ carneæ, ſhoot up into the great veſſels, and hinder the movements, and cloſe, in ſome degree, the openings of the heart, is quite unlikely: yet if there be ſuch a thing, this muſt ſtand as the deſcription of a polypus of the heart. I incline then rather to the opinion of the able and diligent Kerkringius, who calls them pſeudo-polypi, baſtard polypi, mere clots of blood; of which he produces drawings from the pulmonic veins, the liver, the heart, the brain, &c. wherever great veins are.

That when the heart is monſtrouſly dilated, clots may be formed in it, very large, filling all its cavity, but ſtill happening chiefly in the moment of death, or during its flow approaches, I believe from what Veſalius relates; who, "in the heart of a nobleman, found two pounds of a dark coloured fleſh; upon which lump, the heart, of monſtrous ſize, was extended like a gravid uterus." But this black fleſh, ſince it was unconnected with the walls of the heart, was a mere clot; which, had it come really from the womb, Veſalius would have called a falſe pregnancy, an ovum deforme, or what the vulgar call a mole.

This, and all the leſſer polypi, thoſe ſtrings of coagulum which entangle the columnæ, and ſtretch upwards into the veſſels, are really formed in the moment of death. But it is not to be forgotten, that many of the moſt eminent men have thought quite the reverſe of all this. Polypi, when firſt noticed, ſeemed a ſtrange and awful and frequent cauſe of death. Having once believed and wondered at ſuch a thing, people did not even like to be diſabuſed; and when Kerkringius called them pſeudo-polypi, the whole phyſicians, like a hive of bees, ſwarmed out upon him at once. Tulpius, Malpighi, Pechlinus, ridiculed this opinion. Pechlinus was ſo offended, that he could not refrain himſelf from low and mean language. "True polypi there certainly are, ſays he, but theſe polypi of Kerkringius are indeed pſeudo-polypi, and every blind ſhaver knows them abundantly well ;" (tam eſt vulgaris et lippis tonſoribus notus). "The ſhop-boys, ſays Pechlinus, make ſuch polypi, by pouring vitriolic acid into the veins." Yet with all his bitterneſs, Pechlinus has not proved, to my ſatisfaction, either by his arguments, or by his caſes, that polypi exiſt; but he made many believe him, for the ignorance of that time is very ſingular. Dr. Petrus Ruſſe tells us, that he had once found a polypus in the longitudinal ſinus of the dura mater, of a quarter of a yard long: "Let this be put down," ſays he, "as one proof at leaſt that polypi are ſometimes found higher than the noſe." What muſt have been the confuſion of their notions, who could thus jumble the ideas of a polypus of the blood-veſſels and a polypus of the noſe?

They even miſtook ſuch clots for living animals. Dr. Edward May ſent from England to the celebrated Severinus a deſcription of an Eel which he had found in the cavity of the heart. He entitles it, with ſome propriety, "Hiſtoria mirabilis anguis bifidi." It is, indeed, a wonderful ſtory; they deſcribe head and tail, and all fairly, as if it had been *bona fide* a living creature; and tell us how its head was ſticking to the inſide of the heart (where you may ſuppoſe it was biting), and how its body was very white and very ſtrong, and its arms or tails, I do not know what to call them, red. But what amuſes one moſt of all is the important air of theſe communications betwixt Severinus and Dr. May; and then Severinus, warning his pupils againſt incredulity, and telling them, "that though wounds of the heart are really mortal, yet ulcers of the heart certainly are not morta ;" by which he means, that while the Eel was alive it was continually biting the heart *. In ſhort, from theſe things, we perceive that we need not look into books for any ſatisfaction on this delicate point ; that we muſt depend upon ourſelves, and make a better uſe of all future occaſions ; for unhappily there are no good hiſtories attached to thoſe diſſections in which the coagula have been likeſt to thoſe of a long formed diſeaſe †.

The heart, which is ſo often dilated by weakneſs, is ſometimes reduced in ſize by an increaſe of ſtrength and action. It becomes denſe, firm, thick in ſubſtance, but ſmall in its cavity ; it appears to be dilated without, but is, in fact, contracted within. This thickening of the walls of the ventricles is what I cannot underſtand, though I have cut many ſuch hearts with the utmoſt care. There is no oſſification of the valves, no ſtraitening of the aorta, nor any other obſtruction to excite the heart. There is no enlargement of the auricles, no dilatation of the veins, no diſeaſe of the arteries, nothing appears but a thickening, and enlargement, and condenſation of the walls

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* It is certain enough that ſmall worms are found not only in the œſophagus, but in the aorta too, of Dogs and other animals. Vid. Morgagni's *Adverſaria*. For plenty of real worms in the heart, producing St. Vitus's dance in boys and hyſterics in girls, vid. *Sckenkius*, Page 272.

† A caſe liker this diſeaſe than almoſt any other, is a very melancholy and affecting ſtory of a Mr. Holder, an apothecary. Vid. *London Medical Journal* by Simmons, and *London Medical Communications*.

of the ventricles, a proportionate enlargement of the columnæ carneæ, and a proportionate narrowing of the cavity of the heart itſelf. Upon opening ſuch a heart, one would almoſt pronounce it natural. If one ſhould ſpeculate upon its peculiarities, he would (finding the heart ſtrengthened, and its valves and veſſels all found) pronounce that it would cauſe rather a vigorous circulation and ſtrong health: yet I ſhall never forget the miſeries I have ſeen patients endure from having ſuch a heart. They have often a full and bloated habit of body (at leaſt ſo I have chanced to obſerve), a pulſe weak at all times, but trembling, and hardly ſenſible, when a fit of difficult circulation approaches; then the pulſe vaniſhes, the patient ſometimes faints; the anxieties, oppreſſed breathing, languid pulſe, actual faintings, and all the intermediate conditions leſs than fainting, but like it, and infinitely more miſerable, make their chief ſufferings. After ſtruggling long under this diſeaſe, the patients grow languid for a few days, often become dropſical, and then die.

The variety of ſymptoms which thoſe ſuffer who have this ſimpleſt of all the diſeaſes of the heart is very ſurpriſing, and puts to nought all our conjectures about certain ſigns indicating particular diſeaſes of the heart. We cannot be ſurprized that in great enlargements of the auricles, or vaſt aneuriſms of the aorta, or in thoſe enlargements in which ſomething like polypi are found, and where, as Mr. Holder often ſaid of himſelf, the circulation ſeems to go on for a time in one corner, as it were, of the heart; in all ſuch caſes, we cannot wonder at there being heard noiſes like the ruſhing of water. But how ſuch ſhould be heard in this thickening of the heart, I cannot conceive: yet it is certain that one gentleman, whoſe diſeaſe came upon him all at once, and while perfectly at reſt, with the ſudden ſenſe of ſomething burſting within; who had moreover for ſeveral years a palpitation which could be felt outwardly, and a plunging noiſe, which at times the by-ſtanders could hear very loud; who died in the end in great diſtreſs,—had yet none of theſe oſſified valves, enlarged aorta, nor other organic affections, which there was ſo much reaſon to ſuppoſe, but merely this thickening of the ſubſtance of the heart.

Among the diſeaſes of the heart we may reckon the dilatation of the aorta, a diſeaſe more frequent than all the others, and more dreadful. It is a diſeaſe more frequent in the decline of life; it is then a diſeaſe of weakneſs; it ariſes from a cauſe quite different from that which is commonly laid down. The celebrated Dr. Hunter believes that it ariſes from that prediſpoſition or weakneſs which naturally belongs to the form of this part, viz. a ſudden angle of the artery, expoſed in the moſt direct manner to the whole force of the heart. Dr. Hunter alſo believed, that no ſooner is Nature ſenſible of this danger, than ſhe ſeeks to prop up the artery; and for this end thickens its walls till it oſſifies by ſlow degrees. Haller's theory is different from this, and comes nearer to the truth; for he makes theſe ſcales of oſſification not the conſequence, but the cauſe of the diſeaſe. He ſays, the artery becoming ſcaly, and partly oſſified, no longer yields to the force of the heart; and the heart thus excited to a higher action is itſelf dilated, and at laſt forces alſo the aorta. In truth, neither of theſe is the true theory; but the aorta in aged perſons beginning to oſſify, has its middle or muſcular coat annihilated, and its outer and inner coats thickened, by the ſame proceſs. Its muſcular power is loſt; it is no longer capable of withſtanding, much leſs of ſeconding, the ſtroke of the heart by a ſecond ſtroke; it ceaſes to act, ſuffers itſelf to be dilated, and in a few years grows into a dreadful diſeaſe. I never ſaw an old aorta without ſome ſpecks of oſſification, or rather of calcareous concretion, nor an aorta ſo affected which was not dilated in proportion pretty nearly to the degree of this thickening and oſſification; at which we need not wonder, ſince we find not a bone (as it is uſually called oſſified aorta), but a vile calcareous concretion ſubſtituted to its muſcular coat. Nature is not at this time, as Hunter ſuppoſed, building up and ſtrengthening the walls of the aorta againſt this diſeaſe; but taking down ſlowly that fabric which has laſted its appointed time.

However produced, it is an awful diſeaſe; for every organ, when once deranged, eſpecially if it be one as active as this is, never ſtops in its courſe; and this eſpecially ends early or late in ſome terrible kind of death. Sometimes, increaſing in ſize, it deſtroys all the ſurrounding parts and burſts within. Sometimes it burſts into the cheſt, and then the patient drops ſuddenly drown; ſometimes into the trachea, and then the cauſe of the ſudden death is known; for the patient, after violent coughings and ejections of blood by the mouth, expires. Sometimes it bears its way through the ribs, deſtroys the vertebræ, affects the ſpinal marrow; and thus the patient dies a leſs violent or ſudden death. Moſt frequently, the tumour riſes towards the root of the neck, is felt beating there, deſtroys the ſternum, burſts up the ribs, diſlocates and throws aſide the clavicles, appears at laſt in the form of a great tumour upon the breaſt, beating awfully.—A dreadful ſtate! and with nothing to keep in the blood but a thin covering of livid ſkin, which grows continually thinner, till, burſting at laſt, the patient expires in one guſh of blood.

But Nature can ſeldom bear all this diſtreſs; the patient dies before this awful ſcene commences; for the aorta often ſo fills the cheſt, ſo oppreſſes the lungs, chokes the tracheæ, and curbs the courſe of the deſcending blood, that the ſyſtem, with a poor circulation of ill-oxydated blood, is quite exhauſted! And thus, though the patient is ſaved from the moſt terrible ſcene of all, he ſuffers great miſeries: he feels ſharp pains paſſing acroſs his cheſt, which he compares with the ſtabbing of knives and ſwords; terrible palpitations; often an awful ſenſe of ſinking within him; the ſound within his breaſt as if of ruſhing waters; a continual ſenſe of his condition; ſudden ſtartings during the night, and fearful dreams, and dangers of ſuffocation; until with ſleepleſs nights, and miſerable thoughts by day, and the gradual failing of an ill-ſupported ſyſtem, he grows weak, dropſical, and expires.

How, except by attributing them to ſome peculiar weakneſs, to ſome inward prediſpoſing cauſe, ſhall we account for all theſe terrible diſeaſes of the heart? Albertine aſcribed them ſo entirely to the paſſions of the mind, that he gives this as the chief reaſon why in the lower animals * ſuch accidents are not found. This is ſtrange philoſophy; for who does not know that the human paſſions are remarked only becauſe they ſhould be under continual reſtraint and controul? while thoſe of animals paſs thus unnoticed by Rammazini, only becauſe they are wild and furious, and we do not expect that they ſhould be reſtrained. The wild and ungovernable ſpirits of animals would produce ſuch diſeaſes ſurely, if ſuch cauſes could; but whether they do produce them, neither Rammazini nor any of us know; we are too careleſs of this kind of diſſection.

Often, as I have explained, theſe complaints lie dormant for years, till on ſome violent exertion the patient begins to feel them; and when queſtioned by his phyſicians, being himſelf alſo extremely anxious to recollect the cauſe, and always willing to ſatisfy his phyſician, he remembers ſome violent exertion, ſome paroxyſm of paſſion, ſome fit of coughing, or ſomething even leſs important than all this; and tells how from that day he does not think he has enjoyed an hour of health.

That theſe diſorders will ariſe from too violent exertions, independent of all prediſpoſition, we have every reaſon to believe. Sometimes from blows, more frequently from ſhocks or falls (for I have formerly

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* Had Rammazini never ſeen a Dog enraged, nor a wild Bull, nor untamed Horſe, nor a Cat with its back up?

noticed how little there is, except its veſſels, to ſupport the heart, or hang it within the cheſt); but moſt frequently of all have we reaſon to ſuſpect thoſe kind of exertions which are accompanied with a rapid pulſe and hurried reſpiration. Of this kind I muſt ſurely reckon all exertions diſproportioned to the ſtrength, and moſt of all in the time of weakneſs and convaleſcence. Do we not obſerve how in ſcurvy, upon the ſmalleſt exertion, the men drop down dead? how when a ſhip is in danger, and they are pumping day and night with a weakly crew, theſe alſo fall down dead? Do we not often remember, that after fevers young Men, having made raſh exertions during their ſtate of weakneſs, have brought upon themſelves this dreadful diſeaſe? Do we not ſee that boxers, horſe-jockeys, and all the tribe of athletics, cannot make theſe exertions unprepared? And what is their courſe of training, but a ſpare diet of generous food, with regular exerciſe, and gradual exertions; till, at laſt, the two great functions of reſpiration and circulation accompanying each other, are brought to the higheſt pitch; and the man become capable of exertions, before impoſſible or dangerous; now familiar and eaſy to him? For examples of this danger, let theſe ſuffice: A delicate man, little accuſtomed to fatigue, having alighted from his horſe and tied it careleſsly, it eſcaped; and all day long he chaſed it, till, quite exhauſted, he was forced in the evening to give over, breathleſs and palpitating, a hundred times during this vain purſuit. From that day he never had one moment's comfort. In about a year after two throbbing tumours appeared upon his breaſt; and, in the courſe of the ſecond year when he came to me, theſe tumours covered all the breaſt, throbbing in a moſt alarming degree, each of them bigger than two fiſts. At this time he had walked with tolerable eaſe three miles to ſee me; but in leſs than four months he was dead, having lived in the greateſt miſery.

When I cut out the heart, I took alſo the ſternum along with it. I found an aneuriſm of the aorta filling all the cheſt, two fair round holes betwixt the cartilages on each ſide of the ſternum, by which the two tumours were filled; the ribs and ſternum were not eroded, but the intervals betwixt the cartilages dilated; the two tumours were, when the ſternum was cut away, like two great flat cups, cymbal-ſhaped, one a little larger than the other, and each capable of containing about a pound of blood.

It has been known to happen, that a young man, travelling on foot too far, has died in a few days of a prodigious enlargement, with pulſation of the heart. But the caſe which comes neareſt to that which I have juſt related, is that of a man about 47 years of age, who had fallen into the hands of robbers. Theſe men, unwilling to commit direct murder, carried him into an unfrequented place in the foreſt, and there tied him to a tree. Senſible that no human ear could hear his cries, he made the moſt violent ſtruggles, but without ſucceſs. At the diſtance of ſix hours he was found by a hunter accidentally paſſing that way, and ſaved; but not long, for his ſtruggles had produced an aneuriſm of the aorta, of which he died. Upon opening his body there were found two aneuriſms; one in the arch of the aorta, and one in the left ſubclavian artery.

The many caſes in which aneuriſms ſeem to proceed leſs directly from ſtrains, blows, falls, and other miſchances, I will not ſtop to explain; for a thouſand ſuch examples cannot prove that there did not exiſt an abſolute prediſpoſition in each individual caſe. But as I began with repreſenting the marks of ill oxydated blood in a child, I ſhall conclude with repreſenting the condition of a man, which, even by a regular hiſtory, could not be repreſented more faithfully than in this ſingle caſe.

I attended, ſays Morgagni, the moſt excellent Marquis Alloyſis Pallucci, commander of the Pontifical forces at Rome; a man who deſerved a longer and a happier life. His diſeaſe was an aneuriſm in the breaſt: he could neither lie down, nor go to ſtool, nor take nouriſhment, but almoſt inſtantly a paroxyſm was brought on, which threatened inſtant ſuffocation, and ſometimes ſeemed like death itſelf. He never went to bed; he continually reſted on a chair to avoid all motion; but inſtantly upon the attack of difficult circulation, he would leap from his ſeat, and run to the open window, in hopes of breathing there more freely: yet even there he was uſed to draw his breath with a ſtertor; his face was quite livid, he paſſed his urine and feces without conſciouſneſs; often the breathing was ſo very difficult, ſo interrupted, that even the ſnoring ceaſed, and he ſeemed dead, and fell forwards, apparently lifeleſs, into the arms of the two ſervants who continually ſupported him on either hand. This was the degree of his diſtreſs.

But after all theſe dreadful reports of diſeaſed heart, muſt it not be a comfort for us all to know, that often the moſt ſimple affections, ſuch as we call nervous, from peculiarity of conſtitution, or from ill health, reſemble theſe organic diſeaſes, ſo that all the phyſicians on earth could not pronounce upon the caſe? In ſhort, often thoſe which appear to be at firſt the moſt awful diſeaſes, turn out in truth the moſt trivial and temporary. Palpitations and quick breathing are the moſt uſual ſigns. Palpitations, ſays Sckenkius, may ariſe from tubercles, abſceſſes, or congeſtions of blood from worms, from ſtones in the heart, from poiſons. But why diſtreſs us with the catalogue of theſe and many other horrible things, till firſt he have explained palpitation to us as a common but merely nervous diſeaſe, which many feel but few complain of?

Were a man to ſtudy only theſe examples of organic diſeaſe, he muſt of courſe believe that there were no other, and think that every palpitation portended death; while palpitation is, in truth, the nervous diſeaſe of boys and girls, of women, or of weakly men: it alarms the young and the robuſt; while, in fact, organic diſeaſe belongs rather to advanced life, and comes ſeriouſly upon us at a time when all fears about palpitations are paſt and over.

I like what Galen ſays (Lib. de Loc. Affect. cap. ii.) "Palpitatio viſceris hujus, pluribus integra valitudine degentibus, cum adoleſcentibus tum adultis, ſubito, ſine ullo alio manifeſto accidente, evenire viſa eſt." I think it dangerous to add what follows; "atque omnes eos ſanguinis detractio juvit;" for I know ſuch bleeding to be but a temporary relief, more than counterbalanced by a permanent loſs. This text I ſhall explain a very little, and then conclude: for palpitation is, indeed, the diſeaſe of boys and of young men, as I have juſt explained, but not of the aged, in whom chiefly we find organic diſeaſe.

Palpitation is like that fluttering which fear brings on; the heart riſes in its action till it throbs, and beats againſt the ribs; it is ſtrongly felt, it is even audible to the by-ſtanders, and ſtill it is but a nervous diſeaſe. Its intermiſſions uſually diſtinguiſh it from any organic diſeaſe; its paroxyſms laſt for many days or weeks; and for weeks or months again it goes quite away. We ſee it relieved by a jaunt, by living from home and in company, by leaving all buſineſs and thoughts of buſineſs quite behind: we ſee the cauſes which bring it on as plainly as we know the cauſe of marſh fever, or the plague. The confinement even of a boil will cauſe it; the confinement of ſevere ſtudy is ſure to cauſe it; and ſevere ſtudy, with an anxious mind, in a young man unuſed to ſtudy; neglected where he is, and at a diſtance from all his friends, are ſure to produce this diſtreſs. "My ſon, ſays Wierius, "while at Bologna purſuing his ſtudies, had this afflicting palpitation, accompanied with a capricious, frequent, and intermitting pulſe; but by bleeding (which the older phyſicians never neglected), and care, and relaxation from his ſtudies, he got quite well." This is the palpitation which the older authors diſtinguiſhed by the name of palpitatio cardiaca, marking it as proceeding from the ſtomach; equivalent, in the language of the preſent time, to the calling it a nervous diſeaſe.

Theſe, then, are the habits in which it occurs, and this its cauſe: and there remains but two things to be ſhortly obſerved, or rather to be proved, viz. that it is ſometimes as alarming as an organic diſeaſe is; and that bleeding is dangerous in an extreme degree, or at leaſt that it does not, as Galen affirms, "always bring relief."

"Sanctius Velaſco, ſon of the Count Velaſco, had a palpitation of the heart ſo terrible, that I and many by-ſtanders often heard it diſtinctly, as if a ſtone had been plumped into a jug half full of water.*" Yet this boy got entirely well, and his phyſicians made themſelves very happy in the thought that they had cured him, by a ſacculus of aromatic herbs ſteeped in wine applied to the region of his heart; and by the ſame aromatics, or cardiacs as they called them, given along with his food.

I prove the ſecond point, viz. the danger of bleeding, by a moſt alarming caſe, delivered by Morgagni, which I fear might (if it had ſo pleaſed the writers) have had in the records of medicine many precedents; it wholly deſtroys the authority of Galen's rule, and plainly inſtructs us never to bleed. "A boarding-miſtreſs, having a ſlighter palpitation of the heart, was bled with ſome appearance of relief: but after two days her palpitations returned with ſuch violence, that the breaſt ſeemed at every ſtroke to be lifted up; ſhe had withal pain, fever, and difficult breathing. They continued bleeding her firſt in the arm, which did no good; then in the foot, which was abſolutely fatal;

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* Chriſtoph. a Vegas *Ars Medendi*, lib. iii. ſect. 6. cap. 8.

for in an hour after ſhe died, the pulſe becoming quicker inſtantly, and falling gradually lower and lower, and giving leſs reſiſtance to the finger till ſhe expired." In her viſcera both of the belly and of the thorax, every thing was entire, ſound, and natural; and it had been well for the phyſicians who attended her, had they remembered that the very name of palpitatio cardiaca implies a courſe of proceeding quite the reverſe of this.

Thus the ſimple diſeaſe of nervous palpitation is often ill underſtood, and the patient's health abuſed, and his miſeries and agony of mind, and his real diſeaſe, all increaſed, by the ſerious looks of his phyſicians, when, perhaps, it is but a very ſimple caſe.

The French phyſicians, in a very formal conſultation, made a very public miſtake of this kind, in the diſeaſe of Marinus de Caballis, ambaſſador at Paris from the Venetian ſtate. He complained to them of his palpitation and of his intermitting pulſe, and they concealing nothing of their opinion from him, prognoſticated the very worſt; adviſed him to demand his audience of leave, to go off for his native country, and there to make his will, ſettle all the affairs of his family, and then compoſe himſelf for his laſt hour. Having obeyed them in all things, he arrived in Italy very diſconſolate and dejected, and their prognoſtic was well nigh fulfilled. But, like a man who would have another throw for one precious ſtake, he called a conſultation of the college; among whom, happily, was Victor Trincavelli, then profeſſor in the univerſity of Pavia; who, perceiving that ſuch tremors of his pulſe proceeded entirely from the great charge of important matters which lay heavy upon his mind, aſſured him of recovering his health. He ordered frequent bleedings, which the peculiar fulneſs of his habit ſeemed to require; and by cordial medicines he was entirely reſtored, and lived long;—a man of great ſcience, and ſkilful in many languages. After this ſad journey, he performed with much honour to the ſtate two ſplendid embaſſies to the Emperor and to the Turks.

Let no one in future pronounce ſo raſhly; it is time alone, and various modes of living, that can explain to us whether there be in any individual caſe a fixed diſeaſe. Nor would I dare to ſpeak of the organic diſeaſes of the heart, without explaining more fully an idea which Albertine has ſhortly and ſimply expreſſed. "Formerly, in diſeaſed reſpiration, any vitiated ſtructure of the heart and precordia were unheard of; but after obſervations being ſeveral times repeated in dead bodies, the ſame names are too much heard of and too much dreaded in the living.

BOOK II.

OF THE ARTERIES.

GENERAL PLAN OF THE ARTERIES.

AORTA.

THE arteries of all the body, (excepting only thoſe of the lungs employed merely in oxydating the blood) ariſe from one trunk, the aorta; which we muſt deſcribe as of great ſize, ſince we compare it with other arteries, but which is wonderfully ſmall, conſidering that it is of its branches only that the whole body is compoſed.

Thoſe will have the trueſt notion of the diſtorted form of the aorta who have ſtudied the anatomy of the heart. Its root is deep buried in the fleſh of the heart. In the Tortoiſe we ſee the fleſh of the heart riſing round the root of the aorta, and endowing it with the power of a ſecond ventricle: in the Frog we find its internal ſurface beſet with a triple row of valves, and its coats are like thoſe of a ventricle, they are ſo exceedingly ſtrong: In Man we find it plainly muſcular, ſurrounded in circles with great fibres, and having much muſcular power.

The beginning of the aorta, then, lies deep in the fleſh of the heart; it is there that it gives off its coronary arteries; it bulges at its root into three great knobs, which mark the place of its three valves, and are called the leſſer ſinuſes of the aorta; it is large at the root, it grows ſmaller as it riſes, it mounts upwards and backwards from the heart, till it begins to form its arch or curvature; its direction is firſt towards the right ſide of the thorax; looking backwards, it turns in a very diſtorted manner, where it forms the arch; it ſtrides over the root of the lungs, going now to the left ſide and backwards, till it touches the ſpine; its arch lies ſo upon the forking of the trachea, that its aneuriſms often burſt into the lungs: it then applies itſelf cloſe to the ſpine, ſo that in aneuriſms the preſſure of the aorta often deſtroys the vertebræ; and now lying along the left ſide of the ſpine, and with the œſophagus running cloſe by it, it paſſes down through the thorax, and from that to the belly under the legs of the diaphragm.

This, then, may ſerve as a ſhort deſcription of the aorta, which is the root of all thoſe arteries which we proceed now to explain. Its ſtructure is ſtrong, muſcular, and continually active, performing the office of a ſecond heart. When in old age it begins to loſe this muſcular power, to have its fibres embarraſſed with

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chalky, or as they are called bony concretions, it is no longer able to reſiſt the force of the blood; it is not dilated into aneuriſms, becauſe of the acute angle which it makes, and the direct impetus of the blood, for many other arteries turn backwards with very acute angles; the arteries tied in aneuriſms, amputations, and on other occaſions, do not dilate; the inoſculations which ſave a limb after the operations for aneuriſm, receive the blood in a retrograde courſe, and the angles are often very acute, yet they do not dilate too much. The arteries under joints are oftener bent than ſtraight; the aorta of deformed people follows cloſely the deformity of the ſpine, and makes ſuch ſingular angles, that after once ſeeing them no one will talk of angles occaſioning dilatation. The aorta, when dilated, in nine of ten caſes is covered with white ſpots; it is diſeaſed; they are aged people, and almoſt always the dilatation begins from the heart.

THE aorta, then, is the trunk from which the general tree of the arteries is to be explained.

From the arch of the aorta go off three great arteries, which riſe to the head, or bend ſidewiſe towards the arms, and ſo nouriſh all the upper parts of the body. Of theſe three arteries, the firſt is a great one, which contains, if I may ſo expreſs it, the RIGHT CAROTID and the RIGHT SUBCLAVIAN, and divides ſo as to form thoſe two arteries, about one inch after it ariſes from the arch; the next is the LEFT CAROTID ARTERY going to the head; the third is the LEFT SUBCLAVIAN, going to the left arm. Theſe three branches occupy all the arch of the aorta.

RIGHT SUBCLAVIAN.

The right ſubclavian goes off from the aorta in a more direct courſe than the left; it is thought to receive the blood more fully; perhaps, alſo, it is rather larger than the left ſubclavian: but, at all events, there is ſomething peculiar in the mechaniſm of the right arm; moſt probably it is the peculiar form or direction of this artery that gives to the right arm a ſuperior dexterity and ſtrength. When Horſes are to be broken, we find the chief difficulty to conſiſt in teaching them to move equally with both feet, for they prefer the right; when a Dog trots, or when he digs the ground, he goes with his right ſide foremoſt, and digs chiefly with his right foot; and in theſe creatures we find the ſame arrangement of theſe arteries as in ourſelves. When we loſe our arm, the left hand acquires by uſe all the ſtrength and dexterity of the right. Since, then, either arm can acquire this dexterity, and ſince the right leg is ſtronger by its dependence upon the motions of the right hand, we have every reaſon to believe, that the preference given to the right hand has ſome phyſical cauſe, and that it is the peculiar form of this artery, viz. going off more directly on the right ſide, and that thoſe who are ambidexter muſt have the right as well as the left ſubclavian going off as one independent branch.

There is another peculiarity which has occurred. The arch ſometimes gives out four branches, and the left ſubclavian, ariſing firſt from the arch, has paſſed behind the trachea, betwixt the trachea and the œſophagus.

The ſubject dying of difficult deglutition, which has ſubſiſted from childhood, it has been attributed to the preſſure of this preternatural artery, an effect which I cannot eaſily believe; and it has been propoſed to rank it as a new and certainly incurable ſpecies of the diſeaſe, under the title of dyſphagia luſoria, as ariſing from a luſus naturæ of this artery.

CAROTIDS.

THE next branch of the arch is the LEFT CAROTID. The two carotids mount along the ſides of the neck, are felt beating ſtrongly, and ſeem much expoſed. They retire for protection behind the prominency of the thyroid cartilage. They divide into external and internal carotids under the angle of the jaw. The EXTERNAL CAROTID ſupplies the neck, the face, the inſide of the throat; and the reader will have chiefly to obſerve its courſe all along the neck, its branching at the angle of the jaw, and the operations and wounds about the throat, neck, face, and eſpecially about the root of the ear.

LEFT SUBCLAVIAN.

THE left ſubclavian is the third branch of the aorta. Each ſubclavian artery varies its name according to the parts through which it goes. This great artery of the arm is named SUBCLAVIAN under the clavicle, where it gives branches to the neck; AXILLARY in the arm-pit, where it gives branches on the one hand to the ſcapula, on the other to the breaſt. It is named BRACHIAL where it runs down the arm, and where there are few important branches; and, finally, its branches, into which it divides at the bend of the arm, are named RADIAL, ULNAR, and INTEROSSEOUS, becauſe they reſpectively run along theſe parts, the radius, the ulna, and the interoſſeous membrane.

THORACIC AND ABDOMINAL AORTA.

THE aorta, after completing its arch, paſſes through the thorax, giving but few branches, and thoſe very ſlender. But the ABDOMINAL AORTA, as ſoon as it has emerged from under the legs of the diaphragm, gives three great abdominal arteries: Firſt, the CÆLIAC, going in three branches to the liver, the ſtomach, and the ſpleen; ſecondly, the SUPERIOR MESENTERIC, which furniſhes all the ſmall inteſtines; and, thirdly, the LOWER MESENTERIC, which ſupplies moſt of the great inteſtines down to the rectum. The arteries of the kidneys and of the teſticles follow theſe, and then the aorta divides into two great branches for the pelvis and legs.

The ILIAC ARTERIES are the two great branches into which the aorta divides within the abdomen, and theſe again are each ſubdivided into two great arteries; the INTERNAL ILIACS to ſupply the pelvis, the EXTERNAL ILIACS to go to the thigh.

INTERNAL ILIACS.

THE INTERNAL ILIAC ſupplies the bladder, the rectum, the womb, with leſſer arteries; but its great arteries go out by the openings of the pelvis to ſupply the very large muſcles of the hip and thigh. Thus the GLUTÆAL, a very great artery, turns round the bone, goes out by the ſciatic notch, and goes to the glutæal muſcles. The SCIATIC, almoſt equally large, turns down along the hip oppoſite to the glutæal, which turns up. The pudic, of great ſize, alſo turns out of the pelvis, turns inwards again towards the root of the penis, and belongs entirely to the private parts, as its name implies.

EXTERNAL ILIACS.

THE EXTERNAL ILIAC, when it paſſes out of the abdomen, takes the name of FEMORAL ARTERY: it divides into two vaſt arteries a little below the ligament of the thigh: the one goes deep, belongs to the muſcles, is called the PROFUNDA; it furniſhes all the thigh, and it might with the ſtricteſt propriety be named the femoral artery. The FEMORAL ARTERY, as we call it, is the other great branch, which continues ſuperficial, runs obliquely down the fore part of the thigh, gives few and but trivial branches to the thigh, and is really deſtined for the leg. When the artery turns inwards towards the ham, it is named POPLITEAL ARTERY; and, like the artery at the bend of the arm, this one at the bending of the knee divides into three great branches, which, like thoſe of the arm, take their names from the bones along which they run; the ANTERIOR TIBIAL ARTERY lies on the fore part of the tibia; the POSTERIOR TIBIAL ARTERY runs along the back part of the tibia; the FIBULAR ARTERY runs along the fibula; and theſe great arteries terminate by making arches with each other in the ſole of the foot, in the ſame manner that the RADIAL and ULNAR ARTERIES join in great arches in the palm of the hand.

This ſlight plan I have choſen to throw out before my reader, that the ſucceeding parts may ſeem more methodical, and that he may have at a ſlight glance the chief parts of his taſk before him; and knowing all his duty, he cannot be inattentive to that on which the lives of his fellow-creatures muſt ſo often depend.

CHAP. I.

OF THE ARTERIES OF THE HEAD.

SECT. I.

OF THE CAROTID ARTERIES IN GENERAL.

THE carotid arteries are alſo named the Arteriæ Cerebri, as if they were the ſole arteries of the brain; and the ancients, either ignorant or forgetful of there being any other arteries for the brain, or not obſerving that the verbetral arteries might convey blood enough for the functions of the brain, did actually name the carotids the Arteriæ Soporiferæ; believing that, if they were tied, the perſon muſt fall aſleep[*]. How a perſon might die from having the great arteries of the head tied, I can moſt readily conceive; but how he ſhould rather fall aſleep, and not die, is quite beyond my comprehenſion: and yet many of the beſt anatomiſts, in the beſt agé of anatomy, have abuſed their time repeating theſe experiments. Vaſalva, Van Swieten, Pechlinus, Lower, and eſpecially Drellincartius in his Experimenta Canicidia, and many others, ſpent days and weeks in tying up the carotids of Dogs. What does all this imply? Surely a ſtrong belief in tales which would diſgrace the Arabian Nights; tales concerning a manner of tying a cord round the neck of a She-goat, or even of a young Man, ſo that, without hurting them, they ſhould be made to ſleep or wake, according to the bidding of the ſpectators.

Coſtæus firſt tells this tale: "Circumforaneous mountebanks (ſays he[†]) often perform this miracle. They tie a ligature round the jugular veins of a She-goat; and they tighten it and relax it from time to time, ſo that at their pleaſure the animal falls down motionleſs and ſtupid, and at their bidding leaps up again with great vigour." The moſt incredible

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[*] The name which we uſe, viz. that of carotids, is ſynonymous in Greek with Arteriæ Soporales.

[†] Diſquiſitiones Pathologicæ, lib. 6. cap. 6.

dible tales ſoon followed, and ſoon crept into otherwiſe good and uſeful books. Even Hoffman ſeems not unwilling to believe that the Aſſyrians had been in uſe of tying up the jugular veins in their young men before circumciſion, that they might feel leſs pain. A ſerious operation, God-wot! for ſo ſlight a cauſe. Even Morgagni talks more ſeriouſly of the She-goat, and of this ſnibbing of the young men of Aſſyria, than one could wiſh in reſpect to the character of one ſo truly great as Morgagni *. But the perſon the moſt celebrated in this affair was Realdus Columbus; and the wildeſt and moſt barefaced tale that ever was told, is that delivered by his pupil Valverdus in his Anatomy of the Human Body.

" The carotid arteries (ſays Valverdus) being tied up, or any how obſtructed, the perſon grows ſtupid, and falls preſently into a profound ſleep. This experiment I ſaw at Piſa in the year 1554. It was performed upon a young man by the celebrated

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* The celebrated Cant not only believes this moſt powerfully, but reaſons upon it in the following manner: " Ruffus Epheſius, lib. 1. cap. 34. hanc ſoporem adferre negat, hinc aliud nomen permitteret; ſed Realdus Columbus publice in theatro demonſtravit hunc effectum præſtari hac arteria: itaque nomen retinebimus, UTPOTE rei CONGRUENS. Sic enim quotidie experimur poſt prandium ſomnolentiam, quam facile deducere poſſumus ab effectu hujus arteriæ; nam ventriculo extenſo premitur aorta deſcendens, quo ſanguis copia majori ruit in carotides; quæ hinc extenſæ comprimunt cerebrum quodammodo, quo motus animales non ita expedite abſolvuntur, verum vitales augentur motus, quæ ambo fiunt in ſomno." *Tab. Cant impetus faciens*, p. 6.

Columbus in the preſence of a great many gentlemen and ſtrangers, with no leſs miſery to them than amuſement to us (the pupils), who, though we knew the cauſe, aſcribed it altogether to the black art." But if any one word of this were true, Valverdus would have told us, and been proud to tell us, by what particular operation, ligature, or preſſure, this ſtrange thing was performed; and Columbus himſelf, the author of this new amuſement, would ſurely have dropped ſome hints about it in ſome place or other of his works. But from the modeſt ſilence of the maſter and the ſecrecy of the pupil, we have reaſon to believe it is untrue; and if Columbus did ever venture to exhibit ſuch a mean piece of legerdemain, he put himſelf quite upon the level with the quack and his She-goat. The quack, indeed, was much beyond him in point of merit, ſince it muſt have been far eaſier to teach a clever young Man to fall down or ſtart up than to teach all this to a She-goat.

Galen has explained it well, ſaying, "that phyſicians and philoſophers, tying the carotid arteries, tie in along with them the recurrent nerves which ſerve for the voice; and if they will have ſilence to be ſleep, no doubt the creature is mute after their awkward operation; but no other function is hurt neither then nor afterwards."

This is the truth, and the whole truth nearly; for if but one Dog lives after both carotids are tied, nothing can be more certain than that thoſe which die muſt have ſuffered by ſome awkwardneſs or diſeaſe. Is it wonderful that, after ſuch a cruel tedious operation as this is, the Dog ſhould be exhauſted, ſhould be weakened by loſs of blood, ſhould feel ſore, and hang his head and droop, and let the ſlaver fall from his jaws? that he ſhould ſkulk in corners, look ſidelong, be jealous, and not eaſily moved from his hole? Theſe are what they have thought fit to call drowſineſs and ſigns of ſleep; but it is ſuch drowſineſs and ſuch ſleep as would have followed ſuch a cutting-up of the creature's neck, whether the experiment-maker had touched the carotids or not. The creature lolls its tongue, hangs its head, cloſes its watery and heavy eyes, is drowſy, or, in other words, feveriſh for many days: It eats with all the voracity of a Dog, but with difficulty, and ſlowly, owing to the ſwelling of its throat; and if it dies, it dies from the ſame cauſe. Nothing is more certain than that theſe are the only particular effects, and that the carotids of a Dog may be tied without any other danger than that of the wound.

There is nothing new under the ſun. We are continually tantaliſed with old tales in new forms. Who would expect to find at this very day a practical application of the She-goat and the Aſſyrian young Men? One author has publiſhed to the world, "that a young Lady, of a nervous and delicate conſtitution, ſubject to nervous diſtreſſes in a wonderful variety of forms, but more eſpecially in the head, ſometimes afflicted with headachs, ſometimes with delirium, ſometimes with convulſions, was relieved by compreſſing the carotid arteries." Often by compreſſing the carotid arteries, this gentleman prevented the delirium; "for all theſe complaints proceeded from a violent palpitation of the heart with the ſtream of blood ruſhing violently towards the head." He has ſeen this compreſſion bring on a ſtupor; he has ſeen it bring on a profound ſleep. Is it not a pity that he had not attended more to the hiſtory of this buſineſs, and joined to theſe facts the ſtory of the She-goat and the young Men of Aſſyria?

If what Dr. Parry ſays be true, that in lean people, in women at leaſt, we can, by reclining the head backwards, compreſs the carotids entirely againſt the fore-part of the neck with the finger and thumb; why, then, we need have no fear of hemorrhagies of the noſe, wounds about the jaw, cutting the parotid gland, or operations about the tonſils or tongue! But there is a dangerous miſtake here; for there is (as I know by much experience) a wide difference betwixt preventing the pulſe of an artery and ſuppreſſing the flow of blood through it. In the caſe of a Man fainting during any great operation, if you are holding in the blood with the point of your finger upon ſome great artery, you feel the pulſe there, while the face is deadly pale, the extremities cold, and the pulſe of the wriſt and of all but the largeſt arteries gone. In fainting, even the heart itſelf is not felt to move; and yet it moves, and the blood circulates: how elſe could a perſon lie in a hyſterical faint for hours, I had almoſt ſaid days? I have tried, in great operations near the trunk of the body, to ſtop the blood with my hands; but though I could ſuppreſs the pulſe of the femoral artery with my fore finger, I could not command its blood with the whole ſtrength of my body, but have ſeen it with horror ruſh as freely as if my hand had not been there. In ſhort, I ſuſpect Dr. Parry's belief of his ſtopping the carotids with his finger and thumb is as vain as Dr. Monro's expectation of compreſſing the abdominal aorta by puſhing with his fiſt againſt the belly.

THE CAROTID ARTERY, having emerged from the cheſt, runs up along the neck by the ſide of the trachea, a ſingle undivided artery, without twig or branch, till it touches the jaw. The length of this artery gives us a fair opportunity of obſerving, of proving, if we chooſe, that arteries are cylinders, and not, as they once were ſuppoſed, of a conical form. But the cylindrical form of this artery ſhould not occupy our attention ſo much, as that peculiarity of direction which, though apparently expoſed, keeps it ſafe; or thoſe important connections which make it ſo dangerous either to cut or to tie this artery.

Firſt, The carotid artery, from the place where it emerges from the cheſt up to the angle of the jaw, is continually receding from the fore-part of the throat, is getting deeper and deeper by the ſide of the trachea, at laſt the ſtrong projection of the larynx or cartilaginous part of the tube defends it; and when it has got to the angle of the jaw, it lies there ſo deep under the ear, betwixt the ear and the jaw, in a ſort of axilla, as we may call it, filled with fat and glands, that it is almoſt out of reach of danger, unleſs it be ſometimes of the ſurgeon's knife, but rarely of wounds.

This continual retreating of the carotid artery, deeper and deeper as it riſes along the neck, ſaves it from the attempts of ſuicides: it is rarely cut, or when cut, it bleeds ſo that no ignorant perſon can command it, and the ſurgeon is too late. But although tumours and aneuriſms are rare, and through unwillingneſs and a well-grounded fear ſuch patients are uſually left to take their fate; yet there may happen caſes in which it may be neceſſary to do ſo bold a thing as to tie this artery.

Secondly, The connections of the carotid, as it riſes along the neck, muſt determine our judgment, if ever any ſuch caſe ſhould occur. To ſtop the growth of an aneuriſm, to allow the extirpation of other tumours about the jaw, to ſave a patient from dreadful bleedings of the throat, or from the hemorrhagies of deep wounds, when, for example, a patient is ſtabbed in the neck, or a ball paſſes through the mouth and under the angle of the jaw; theſe may, in ſome unlucky moment, preſent themſelves as motives for tying the trunk of this artery, when all its great branches are torn. But always the obſervation of Galen is to be remembered, that the nerves accompanying theſe arteries are liable to be tied together with them.

Let us recollect how the carotid artery, jugular vein, and eighth pair of nerves, come out from the ſkull, for it is almoſt at one ſingle point. The carotid artery enters by a hole in the petrous bone; the jugular vein comes out by a larger hole in the ſame bone, the foramen lacerum; immediately behind it the eighth pair of nerves, or the par vagum, goes out through a diviſion of the ſame foramen lacerum, ſeparated from the vein only by a little croſs ſlip of the dura mater; and ſo the carotid artery, jugular vein, and eighth pair, touch each other at the baſis of the ſkull. Through the whole length of the neck they continue the connection which is thus early begun. They are, indeed, incloſed in one ſheath of cellular membrane; ſo that what touches the one almoſt inevitably affects the other. The par vagum being the great nerve of the viſcera, at leaſt of the ſtomach, ſtrictures upon it or wounds are certainly fatal. A ſurgeon might eaſily, if it were poſſible for him to be called in time, take up the gaping mouth of the artery ſafely when it were cut acroſs; yet in moſt of ſuch caſes the nerve being alſo cut, the operation would be fruitleſs. But as for a deliberate diſſection of the ſkin, the artery beating furiouſly, and the parts embarraſſed with any tumour, and the operator alarmed with a deluge of blood from the veins; that, I think, would be a bold ſtep. In ſhort, the neceſſity of any ſuch operation is reduced to the accident of tumours or wounds about the angle of the jaw; in which caſes, the ſponge thruſt down into the wound will almoſt always check the blood.

When the common carotid has riſen to the angle of the jaw, it divides into two great arteries, one going to the outſide of the head, the other to the brain; the one of courſe named the EXTERNAL, the other the INTERNAL CAROTID. Some of the moſt eminent anatomiſts are incorrect when they ſay, that the carotid artery gives no branches till it arrives at the larynx. They ſay ſo becauſe the firſt branch goes to the larynx; but, in fact, the carotid paſſes much beyond the place to which it is to give its firſt branch, for inſtead of branching at the larynx, it does not do ſo till it arrives at the corner of the jaw; there, as I have obſerved, it can, as in an axilla, lie deep and ſafe; and the laryngeal artery, which is the firſt branch

of

branch of the carotid, turns downwards again to touch the larynx.

The firſt diviſion, then, of the carotid artery is into the external and internal carotids; and the external carotid gives branches ſo intereſting to the ſurgeon, yet ſo numerous, that it is at once very deſirable and very difficult to get a knowledge of each: arrangement is here of more importance than in any order of arteries, though extremely uſeful in all.

ARRANGEMENT OF THE BRANCHES OF THE EXTERNAL CAROTID ARTERY.

THE external carotid gives three ſets of arteries; each of which, having a plain and diſtinct character, cannot be forgotten, nor their direction, nor their uſes, nor their relative importance, miſconceived; for if we conſider but the parts along which the carotid artery paſſes, as 1. The thyroid gland; 2. The tongue; 3. The face; 4. The pharynx; 5. The occiput; 6. The ear; 7. The inſide of the jaws; 8. The temple:—if we remember thus the order of theſe parts, we ſhall not forget the order in which the branches go off.

But it will be further very uſeful to obſerve, that theſe many branches divide themſelves moſt naturally into three ſets.

1. The branches which go off from the carotid forwards are peculiarly important; one of them goes to the thyroid gland, another to the tongue, and a third to the face; parts which, to ſay no more, are

peculiarly expoſed; but they are, beſides, the ſubject of many particular operations.

2. Thoſe branches which go backwards and inwards, as the pharyngeal, the auricular, and the occipital arteries going to the ear the pharynx and the occiput are both extremely ſmall, and alſo run ſo deep, that wounds of them are rare and of leſs importance, and fortunately thoſe branches are the only ones which it is difficult to remember.

3. The great artery which paſſes behind the lower jaw, named maxillary artery, and the temporal artery which lies behind the jaw, imbedded in the parotid gland, muſt be ſtudied with particular care; the difficulty of cutting tumours here, the courſe of the temporal artery in which we bleed, and which, lying imbedded in the parotid gland, demonſtrates the abſurdity of talking about cutting out the parotid gland, ſince plainly it cannot be done; and, laſtly, the terrible hemorrhagies which often happen from the throat, noſe, tonſils, &c. gives an importance to theſe two branches above almoſt any other. They ſhould be very familiarly known to the ſurgeon.

Theſe, then, are the three diviſions of the external carotid artery which are to be deſcribed.

FIRST ORDER,

INCLUDING the arteries which go forward to the thyroid gland, tongue, and face.

I. ARTERIA THYROIDEA.

THE THYROID ARTERY, often alſo named the upper laryngeal artery, comes off from the external carotid almoſt in the very moment in which it ſeparates from the internal carotid, and ſometimes (the thyroid being always a very large artery) the carotid ſeems to divide into three branches, viz. the INTERNAL CAROTID, the EXTERNAL CAROTID, and THYROID arteries.

The THYROID, then, goes off the firſt branch; its place is behind the angle of the jaw; it goes downwards and forwards in a very tortuous form, till it arrives at the thyroid gland, upon which it is almoſt entirely expended; but yet it gives ſome branches, or rather twigs, of which the following are the chief:

1. One ſuperficial branch goes upwards to the os hyoides, and ſends its twigs, ſometimes under, ſometimes over, the os hyoides: it belongs chiefly to that muſcle and to that piece of membrane which join the os hyoides with the thyroid cartilage, named muſculus hyo-thyroideus. This branch is both long and beautiful; it meets its fellow of the oppoſite ſide with free inoſculations; its ſupplies cutaneous twigs, and twigs to the platiſma myoides.

2. A ſecond ſuperficial twig goes downwards to the lower part of the thyroid cartilage, where it meets

the cricoid, and there gives little arteries to the maſtoid muſcle, jugular vein, and ſkin.

3. There is another branch which proceeds frequently enough from this ſecond one: it belongs entirely to the larynx, for which reaſon the thyroid is often named the ſuperior laryngeal artery: it dives immediately betwixt the cartilages of the larynx; it enters betwixt the thyroid and cricoid cartilages, carries in along with it a twig from the eighth pair of nerves; it gives its twigs to the epiglottis, and to all the ſmall muſcles which lie under cover of the thyroid cartilage, and which move the little arytenoid cartilages; and then paſſes outward emerging from the larynx, and appears again ſupplying the cryco-thyroideus muſcle.

4. The fourth branch of the thyroid is properly the main artery, or continuation of this branch into the ſubſtance of the thyroid gland; it applies itſelf to the ſide of the gland, nouriſhes its ſubſtance by a great many ſmall branches into which it is divided. Theſe branches are all oblique, tending downwards and forwards. Their courſe is upon the ſide of the gland, becauſe, indeed, the gland conſiſts chiefly of two lateral lobes, and hardly any of the gland, or only a ſmall portion croſſes the trachea; conſequently this artery does not inoſculate ſo much with its fellow of the oppoſite ſide as with the lower thyroid, which comes from the axillary artery, and whoſe branches, mounting upon the lower part of the gland, have pretty nearly the ſame degree of obliquity with thoſe of the upper thyroid.

2. ARTERIA LINGUALIS.

THE LINGUAL ARTERY is one of which the four branches are nearly of an equal ſize, and which of courſe require all of them to be equally well remembered. It is next to the thyroid, comes off immediately above it, goes forwards towards the os hyoides, and at the ſame time upwards towards the tongue; but all along it lies flat upon the ſide of the tongue upon its fleſh or muſcles, and gives the following branches.

1. Upon paſſing the horn of the os hyoides, it gives firſt one twig of leſs note backwards to the conſtrictor pharyngis, at the place where that conſtrictor ariſes from the horn of the os hyoides (viz. the conſtrictor medius); and it gives another branch forwards round the baſis of the os hyoides, where it meets its fellow: and to thoſe who are acquainted with the muſcles which ariſe from the os hyoides, it is needleſs to ſay what muſcles it ſupplies *. This, which is named the RAMUS HYOIDEUS, ſeems to be very neceſſary, becauſe it is a very conſtant branch; and when it does not come from the lingual, it infallibly ariſes from ſome other, commonly from the labial artery.

2. DORSALIS LINGUÆ is a branch which goes off from the lingual at the inſertion of the ſtylo-gloſſus muſcle into the tongue: it turns firſt outwards a little, and then inwards over the root of the tongue, where the arteries of the oppoſite ſides meet, and form a ſort of net-work. Its chief branches are directed backwards towards the epiglottis and mouth of the pharynx amygdalæ, &c.

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* Viz. the hyo-gloſſus, digaſtricus, mylo-hyoideus, the coraco-hyoidei, ſterno-hyoidei, and hyo-thyroidei.

About the middle of the tongue, or about half way to the chin, meaſuring along the jaw, the lingual artery forks into two branches; the one below the tongue, the ſublingualis, belongs to the ſublingual gland and ſurrounding parts; the other remaining at the root of the tongue, belongs to the tongue itſelf.

3. SUBLINGUALIS then ariſes next; it comes from the ſide of the artery next the tongue; it runs under the ſublingual gland, covered like it by the genio-hyoideus muſcle, and emerges only when it arrives at the chin, where it terminates in the ſkin. Its branches are chiefly to the ſublingual gland, which lies over it, and to the genio-hyoidei and mylo-hyoidei muſcles and ſkin, for theſe are the parts which immediately cover it.

4. The ARTERIA RANINA is the larger branch of theſe two; it runs along the root of the tongue quite to the tip of it. In this courſe it is accompanied by its vein, which appears on the inſide of the mouth when we turn up the tip of the tongue. This is the vein which the older phyſicians were ſo fond of having opened in ſore throats; the artery is that which we are ſo apt to cut in dividing the frenulum linguæ; an awkwardneſs from which a great many children have died.

N. B. It runs along the genio-gloſſus, which is the innermoſt muſcle of the tongue.

3. ARTERIA LABIALIS.

THE labial artery is named occaſionally the EXTERNAL MAXILLARY artery, to diſtinguiſh it from one which goes off at a higher point, and goes to the inſide of the jaw; or ANGULARIS, becauſe it goes to the corner of the mouth and there divides; or FACIALIS, implying, that it ſupplies the face, as indeed it does as far as the angle of the eye and forehead, where there are other ſmall arteries. Haller adheres to this name of LABIALIS, and in compliment to him we adhere to it.

This artery is ſtill carefully kept down in the deep angle; although it is to come out upon the jaw, yet it is not expoſed till it actually makes its turn: it lies under the ſtylo-hyoideus and the tendon of the digaſtric muſcle: it is very tortuous, that it may move along with the jaw, and lies ſtill ſo deep, even when it approaches the jaw-bone, that it is forced to make a very violent and ſudden angle when turning over it. This ſudden turn, which is ſometimes almoſt a circle, is made, as it were, in the heart of the great ſubmaxillary gland, the artery being buried under it. The labialis is a very large artery, very tortuous; ſometimes one great trunk gives off two important arteries at once, the lingual and the facial; in which caſe they ſeparate juſt at the angle of the jaw, where the artery, dividing the ſubſtance of the gland, is quite imbedded in fat. When we conſider how deep this artery lies according to this general deſcription, and the parts which it paſſes along, it becomes eaſy to foreſee what branches it will give, and to trace them in imagination.

1. Where it lies the deepeſt upon the ſide of the pharynx, it ſends a branch directly upwards, which goes ſtraight to the arch of the palate, ſpreading its ſmall

twigs upon the arch of the palate, upon the velum palati and upon the uvula: it uſually has two ſmall branches for ſupplying theſe parts, one ſuperficial and one deep; and thus the labial gives a particular artery to the palate, named ARTERIA PALATINA INFERIOR.

2. It gives a particular artery to the tonſil, which ariſes at that point where the ſtylo-gloſſus begins to mix with the other muſcles of the tongue. This little artery penetrates the walls of the pharynx upon which it lies, and ſpreads its many twigs upon the tonſil and tongue.

3. While paſſing through the ſubmaxillary gland, dividing it, as it were, into two parts, the labial artery gives a great many ſmall twigs into the ſubſtance of the gland itſelf; and after theſe it gives many twigs to the tongue, the ſkin, the muſcles, &c. Of theſe, two chiefly are remarkable; one, which goes to the pterygoid muſcle chiefly, though it alſo gives branches to the conſtrictors of the fauces and palate, and to the root of the tongue; and another artery, more conſtant and regular, which breaks off at the place where the labial artery curls and bends to turn upwards: it runs ſuperficially, and goes ſtraight forwards to the root of the chin, where it is named ARTERIA SUBMENTALIS: it turns upwards over the chin to the face at the middle of the chin, and often inoſculates with ſome of the arteries of the face: it ſometimes comes from the ſublingual artery.

But the artery having emerged from betwixt the lobes of the ſubmaxillary gland (for this artery in a manner divides it into lobes), and from among the fat with which it is ſurrounded, makes a ſudden turn over the angle of the jaw at that point where we feel it beating ſtrongly; and then mounting upon the face, begins to give a new ſet of arteries.

1. A branch to the maſſeter muſcle; for the labial artery paſſes over the jaw, and up the face, juſt at the fore edge of the maſſeter muſcle; and this branch inoſculates with a twig deſcending over the ſurface of the maſſeter from the temporal artery.

2. The labial artery aſcending in the holloweſt part of the cheek, and lying flat upon the buccinator muſcle, gives out ſmall branches to it, which inoſculate chiefly with the tranſverſalis faciei, another branch, and a very great one, coming from the temporal artery acroſs the face. Here alſo the main artery has ſtill a very ſerpentine line, on account of the continual motions of the part.

3. Before the artery comes to that point where it is to give off the coronary artery of the lower lip, it gives a branch named labialis inferior; which artery belongs to the lower part of the lower lip: its branches go to the triangularis and quadratus muſcles, which lie on the chin and on the ſide of the chin, and alſo to the lower part of the orbicularis oris. This branch inoſculates particularly with a twig, which comes from within the lower jaw through the mental hole, and with its fellow, and of courſe with the coronary arteries which run immediately above it, viz. in the red part of the lip.

The artery now divides into two branches, one for each lip, named the CORONARY ARTERIES, becauſe they always ſurround the lips entirely, though their manner of going off is not perfectly regular. The lower coronary artery is uſually ſmaller, and is to be named the branch, while the upper one not only ſurrounds the lip, but mounts along the ſide of the noſe; it is larger; and is therefore to be conſidered as the continued trunk. We frequently obſerve the upper coronary larger on one ſide of the face, and the lower coronary larger on the other.

4. The LOWER CORONARY comes off about an inch or more from the angle of the mouth, at that point where the triangularis oris and many other muſcles meet. It goes directly forwards to the angle of the mouth, enters into the lower part of the lip, and runs along the red pulpy part of it, where with the finger and thumb it can be felt beating. It inoſculates with all the arteries formerly mentioned; as the ſubmental, the twig which comes through the hole near the chin, the inferior labial artery, and with its fellow. With all theſe it inoſculates ſo freely, that it ſignifies little from which ſide your injection is driven: it goes freely all round the lips, and the arteries are everywhere equally filled.

5. The UPPER CORONARY ARTERY we are to conſider as the continued trunk. The labial artery is ſtill riſing, and ſtill tortuous, when it arrives at the angle of the mouth; runs into the border or fleſhy part of the upper lip, and runs along it till at the middle of the lip it meets its fellow of the oppoſite ſide, with a very free inoſculation: yet the two arteries do not terminate here, but uſually two very delicate arteries aſcend towards the point of the noſe, along that little ridge from the noſe to the lip which we call the filtrum; and almoſt always two conſiderable arteries

run up by the ſides of the noſe, one on each ſide; give off branches to the alæ naſi and to the cheeks; and growing gradually ſmaller, they arrive at laſt near the angle of the eye, and inoſculate pretty freely with that artery, which is named ophthalmic, becauſe it firſt nouriſhes the parts of the eye with many branches, and then comes out of the orbit at the corner of the eye, where, though ſmall, it may be felt beating diſtinctly.

SECOND ORDER.

THE ſecond ſet of arteries, which go backwards from the external carotid, comprehend the pharyngeal, the occipital, the auricular.

4. PHARYNGEA INFERIOR.

THE LOWER PHARYNGEAL* is a ſmall ſlender artery, which gives no branches deſerving to be numbered; it ſtands alone, and ſhould be deſcribed as one ſimple artery, whoſe ſmall branches ſpread all about the throat in the following manner.

This artery is ſmaller than any other branch of the carotid yet enumerated. It ariſes oppoſite to the lingual artery; and as it ariſes from the inner ſide, it comes out in a manner from the fork betwixt the external and internal corotid arteries: it riſes upwards very ſlender and delicate; it lies deep in the neck, upon the fore-part of the flat vertebræ, or rather lies upon the flat face of the longus colli muſcle *. After riſing in one ſlender artery, ſingle, without branches or connections, it begins all at once to give twigs.

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* It is named lower pharyngeal, to diſtinguiſh it from one which comes downwards from the internal maxillary. Vide p. 285.

Firſt, It gives branches inwards to the throat; for one twig ſurrounds the lower part of the pharynx about the root of the tongue, and ſometimes goes forwards along with the gloſſo-pharyngeal nerve into the tongue. Another twig goes to the middle of the pharynx, and wanders towards the velum palati, giving branches to the amygdalæ. And ſtill another goes higher towards the baſis of the ſkull; it alſo gives twigs to the velum palati, to the back of the noſtrils, to the upper part of the pharynx where the upper conſtrictor lies (viz. that which comes from the baſis of the ſkull), and it gives ſmall arteries to nouriſh the baſis of the ſkull; as, to the os ſphenoides, to the cuneiform proceſs of the occiput, to the point of the temporal bone, and to the cartilage of the Euſtachian tube.

Secondly, It ſends branches outwards to the maſtoid muſcle, to the jugular vein, to the ganglion of the intercoſtal nerve, and to the dura mater of the eighth pair; and one particular branch, very ſmall

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* When diſſected, it muſt be taken out in a manner from behind the œſophagus. The carotids muſt be raiſed outwards before it can be ſeen; for it lies under them, betwixt them and the throat.

and delicate, goes along conducted by the great jugular vein, enters together with it into the ſkull, and makes one of the arteries of the dura mater, but it is a very delicate twig. In general one artery only of the dura mater is known or mentioned; but here we have ſeen, beſides the great artery of the dura mater, leſſer arteries entering to it by all the perforations at the baſis of the ſkull. The pharyngeal actually terminates in the dura mater, paſſing through the foramen lacerum anterius, and ſending alſo a branch in together with the jugular vein. The occipital artery alſo ſends one with the jugular vein, one by the foramen maſtoideum, and one by a ſmall hole in the occiput. The temporal often ſends one through by the hole in the back part of the parietal bone.

5. ARTERIA OCCIPITALIS.

THE OCCIPITAL ARTERY is alſo a ſimple artery, diſtributing its twigs about the ear, over the occiput, and down the back of the neck, and having no branches of ſufficient importance to be particularly marked.

It ariſes next to the pharyngeal from the back part of the carotid; and lying particularly deep, it not only is covered at its root by the other branches of the carotid, but is covered in all its courſe by the thick muſcles of the neck, except juſt where it is paſſing round the maſtoid proceſs.

At firſt the occipital artery lies cloſe in among the bones, paſſing over the tranſverſe proceſs of the atlas, croſſing the root of the great jugular vein, and paſſing under the root of the maſtoid proceſs, ſo as to lie at this place under the belly of the digaſtric muſcle. Still as it encircles the occiput, it paſſes along very deep under the bellies, firſt of the trachelo-maſtoideus, and then of the ſplenius and complexus, and emerges only when it arrives at or near the middle ridge of the occiput; and laſtly, it riſes with many beautiful branches over the back of the head, to meet the branches of the temporal artery.

In this courſe the occipital artery ſends out the following branches:

1. Branches to the biventer, which lies over it, and to the ſtylo-hyoideus muſcle; and there is one longer artery which attaches itſelf to the root of the maſtoid muſcle, and paſſes along that muſcle, to inoſculate with the thyroid arteries, or with the lower cervical arteries, which mount upwards as this deſcends.

2. Next it gives, like the pharyngeal, a ſmall artery, which goes backwards along the jugular vein; and having entered by the foramen lacerum, attaches itſelf within the ſkull to that part of the dura mater which lies under the lobes of the cerebellum.

3. The occipital artery, as it paſſes under the ear, ſends out to it a ſmall poſterior artery, which goes to the little lobe of the ear, and creeps up along its poſterior border.

4. At this point the occipital often gives another artery, which paſſes upwards behind the ear, and is named the POSTERIOR TEMPORAL ARTERY.

5. The occipital artery, as it paſſes under the trachelo-maſtoideus and ſplenius, gives branches to theſe two muſcles; and it ſends out from betwixt the trachelo-maſtoideus and complexus a long branch, which deſcends along the neck a conſiderable way; and after having further ſupplied the ſplenius, complexus, and alſo the deeper muſcles of the neck, it terminates by inoſculating with a branch from the axillary artery, which as it croſſes the neck is named tranſverſalis colli. This deſcending branch of the occipital inoſculates alſo with the vertebral arteries through the interſtices of the vertebræ.

Having pierced the belly of the complexus, the artery now riſes over the occiput in ſmall and beautiful arteries; the chief of which belong to the occipital belly of the occipito-frontalis muſcle and to the ſkin: it finally ends in inoſculations with the back branches of the temporal artery. But of theſe extreme twigs of the occipital, two are remarkable, becauſe they paſs through the ſkull to the dura mater; one through a ſmall hole in the occipital ſpine, and one through that ſmall hole which is behind the maſtoid proceſs. Sometimes the hole is in the temporal bone, but more frequently in the ſuture which ſurrounds the back part of the temporal bone *.

6. ARTERIA POSTERIOR AURIS.

THE POSTERIOR ARTERY OF THE EAR is the ſmalleſt and leaſt conſtant of all the arteries which go off from

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* Viz. the additamentum ſuturæ ſquamoſæ.

the carotid; for it is often wanting, or often comes from ſome branch, and not from the carotid itſelf; often from the occipital, ſometimes from the pharyngeal artery; it can ſcarcely be reckoned as a regular branch of the carotid. This artery alſo, like the pharyngeal and occipital, gives out no diſtinguiſhed branches which we need to mark; it chiefly belongs to the ear, it gives branches to the cartilage of the external ear, it ſends a larger branch through the ſtylo-maſtoid hole to the internal ear, and the reſt of its twigs go to the integuments, or to the bones.

The POSTERIOR AURIS ariſes much higher than any of thoſe arteries which have been juſt deſcribed; it does not come off from the external carotid till it reaches the parotid gland; or rather, it ariſes where the carotid is plunged into the ſubſtance of that gland; it paſſes directly acroſs under the ſtyloid proceſs, and over the belly of the digaſtric muſcle, and then goes up behind the ear: in this paſſage it gives branches to the patrotid gland, and to the biventer muſcle, the parts on which it lies; next it gives a twig, which furniſhes the root of the cartilage of the ear, and perforates the loweſt part of the cartilage, ſo as to ſpread itſelf upon the drum of the ear; and this branch, named ARTERIA TYMPANI, is particularly large in the child, which has a peculiar conformation, a preternatural membrane covering the drum of the ear.

Its next branch, the ARTERIA STYLO-MASTOIDEA: is the moſt remarkable, for it is of conſiderable ſize: enters the maſtoid hole, while the corda-tympani, or great nerve of the face, comes out: it is a chief arter of the internal ear; for it gives branches, 1. to th tympanum, one of which beautifully ſurrounds the bony circle, and then ſpreads upon the membrane itſelf; 2. to the muſcle of the ſtapes, to the ſemicircular canals, to the cells of the maſtoid proceſs and its delicate veſſels; which arteries, when well injected with ſize, paint the walls of the cavity of the tympanum, and of the ſemicircular canals.

The main artery having given off the arteria tympani and this ſtylo-maſtoid artery, and having paſſed the ſtylo-maſtoid hole, becomes properly the arteria poſterior auris, riſing behind the ear, and giving its branches to the ſkin and maſtoid muſcle, and to the muſcle behind the ear (poſterior auris), and to the bone and perioſteum, chiefly about the maſtoid proceſs; then its ſmall branches play round the back part of the concha or ſhell of the ear; and, laſtly, the artery, ſtill mounting behind the ear, ends in ſmall twigs, which go to the faſcia of the temporal muſcle, and which of courſe inoſculate above the ear with the temporal artery.

THIRD ORDER.

THE third order of arteries includes the termination of the external carotid artery in the temporal nd maxillary arteries, which is after the following manner:

The artery having entered into the parotid gland, ies there abſolutely imbedded in its ſubſtance; and of he two arteries in which it terminates, one paſſes irectly through the ſubſtance of the parotid gland, emerges before the ear, mounts upon the temple, and is named of courſe the TEMPORAL ARTERY; it performs here in the temple the ſame office which the occipital does behind, viz. it ſupplies the pericranium, muſcles, and ſkin: all this is very ſimple. But the other branch, in which (ſince it is exceedingly large) one would ſay the carotid terminates, goes off from the temporal with a ſudden bend, ſinks very deep under the articulation of the lower jaw, terminates in a laſh of branches at the back of the antrum Highmorianum, and there gives branches to the lower jaw, the upper jaw, the inſide of the cheeks, to the temple (deep arteries which lie under the temporal muſcle), to the upper part of the pharynx, to the noſtrils, and to various other parts; it is this artery too which gives off the chief artery of the dura mater. The deſcription of ſo great an artery, ſo widely diſtributed, becomes both difficult and important.

7. ARTERIA MAXILLARIS INTERNA.

THE INTERNAL MAXILLARY ARTERY turns off from the temporal artery while imbedded in the ſubſtance of the parotid gland, and about the middle of the upright branch or proceſs off the lower jaw-bone. It paſſes betwixt the lower jaw-bone and the outer pterygoid muſcle; it then goes forwards till it touches the back part of the antrum maxillare, and terminates in a laſh of veſſels betwixt the back of the antrum and the pterygoid proceſs; and, finally, it ends at the ſpheno-maxillary fiſſure, or, in other terms, at the bottom of the ſocket of the eye, where it gives the infra-orbitary artery, and a branch to the back of the noſtrils.

In all this courſe the internal maxillery artery is extremely tortuous: Firſt, It riſes with a high and round turn at that point where it goes off from the temporal artery; then it bends ſuddenly downwards, where it paſſes betwixt the pterygoid muſcle and the jaw-bone; then, as it approaches the back of the antrum, it riſes with a third bending, and continues riſing with very great contortions, till it ends in a laſh of ſmall veſſels at the back of the eye and noſtrils.

Before this artery gives out its greater branches, which require to be marked with numbers, it very generally gives ſome ſmall twigs, nameleſs, and of leſs note; as a ſmall twig to the ear, and the glands around it, another which gets into the tympanum to the muſcle of the maleus, and a branch of it ſometimes goes into the ſkull by that hole named foramen ovale, by which the fifth pair of nerves come out, and goes to that part of the dura mater which covers the ſides of the ſella turcica.

1. Of the larger branches which the internal maxillary gives out, the firſt is the ARTERIA MENINGEA, the great or MIDDLE ARTERY of the DURA MATER. It goes off from the maxillary juſt where it leaves the temporal artery. Sometimes before entering the ſkull it gives ſmall branches to the pterygoid muſcle, to the mouth of the Euſtachian tube, to the os ſphenoides, and ſometimes through that bone to the dura mater; but the main artery paſſes through what

is called the ſpinous hole, which is in the very extreme point or ſpine of the ſphenoid bone: it is this artery of which the ſurgeon ſhould be particularly aware, and which touches the parietal bone at its loweſt corner in the temple, and ſpreads from that point all over the dura mater like the branches of a tree. But beſides theſe, its chief branches, which ſpread thus upon the parietal bone, on its inner ſurface, it gives ſmaller ones, which go into the ſubſtance of the bone, or into the ear, and ſometimes through the orbit into the eye. Thus firſt ſeveral ſmaller twigs go into the ſubſtance of the os petroſum to nouriſh it; the holes may be ſeen about the rough part, where the os ſquamoſum and os petroſum are united; next two twigs enter into the aqueduct by the ſmall hole on the fore part of the petrous bone, one keeping to the canal itſelf, the other going to the cavity of the tympanum, and to the inner muſcle of the maleus; and, laſtly, one or two ſmall twigs paſs through the outer end of the foramen lacerum into the orbit, and go to the lachrymal gland *.

2. The LOWER MAXILLAR ARTERY is a ſlender and curious artery, which belongs chiefly to the teeth of the lower jaw, and which runs all along in a canal within the jaw-bone. The internal maxillary proceeds nearly an inch before it gives off this branch; and then, while lying under the pterygoid muſcle, it gives it off a long and ſlender artery, which enters the jaw-bone

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* Sometimes the great and proper artery of the lachrymal gland, inſtead of ariſing from the ophthalmic or proper artery of the eye, ariſes thus from the artery of the dura mater.

bone at that great hole which is betwixt the condyloid and coronary proceſſes; then runs all along within the jaw-bone, ſurrounding each of the teeth with arteries at the bottom of each ſocket. About the middle of the jaw-bone it divides into two branches, which proceed together in the bony canal; till one of them emerges upon the chin at the mental hole, inoſculating there with the arteries of the face, viz. the labial and ſubmental arteries, while the other goes onwards to ſupply the roots of the fore teeth alſo, and to meet its fellow within the jaw-bone at the chin. The nerve for the lower jaw enters along with this artery; the vein of this artery accompanies it, but lies under it in a ſeparate canal, though ſtill in the ſame line. The artery itſelf, before it enters into the hole of the lower jaw, commonly gives twigs to the inner pterygoid muſcle which covers the hole. Conſidering the ſize of this artery, we cannot wonder at profuſe bleedings from the teeth, or rather from their ſockets.

3. THE PTERYGOID ARTERIES.—While the artery is thus croſſing betwixt the jaw and the pterygoid muſcle, it gives branches to the external pterygoid muſcle, both into its ſubſtance and over its ſurfaces. The number of theſe pterygoid arteries is variable and unimportant.

Next, while the maxillary artery is paſſing in a contorted form under the zygoma, where the temporal muſcle is lodged, it gives off two arteries, which are called the DEEP TEMPORAL ARTERIES, to diſtinguiſh them from the proper temporal artery, the only one which we feel outwardly, and which is ſuperficial. Of theſe two deep temporal arteries, one runs more outwards, viz. towards the ear, the other runs more inwards, viz. cloſer upon the bone; whence the one is called the DEEP EXTERNAL, the other the DEEP INTERNAL, TEMPORAL ARTERY.

4. The DEEP EXTERNAL TEMPORAL ARTERY ariſes where the maxillary is paſſing under or near the jugum; it is of courſe near the coronary proceſs of the jaw-bone. This branch then paſſes along the tendon of the temporal muſcle, and ends in that muſcle, giving branches alſo to the external pterygoid muſcle; it is a ſhort artery, and not very important by its ſize.

5. The deep internal temporal artery ariſes farther forwards, viz. where the artery is cloſe upon the back of the antrum; from which point, mounting directly upwards, it paſſes in the very deepeſt part of the temporal arch, viz. that which is formed by the cheek-bone. It is longer and more important than the outward branch, ſupplies the deepeſt and thickeſt part of the temporal muſcle, mounts pretty high upon the temple betwixt the muſcle and the bone, and often, where it lies behind the cheek-bone, it ſends a branch through that bone into the orbit which ſupplies the fat and perioſteum of the ſocket, and in ſome degree alſo the lachrymal gland.

6. The ARTERY OF THE CHEEK is a very regular artery, in ſo far as regards its deſtination, viz. for the cheek; but in its origin it is extremely irregular. It has not often the importance of coming off as a diſtinct branch from the maxillary; but comes off rather more frequently from ſome of its branches, as from the deep temporal artery juſt deſcribed, or from the

alveolar or infra-orbital arteries, which are preſently to be deſcribed. This artery perforates the buccinator muſcle, and is ſpent upon it, and upon the other muſcles of the cheek, as the zygomaticus and levator labii; it ends, of courſe, by inoſculations with the arteries of the face.

7. The ARTERY OF THE UPPER JAW ſerves much the ſame office with that of the lower jaw, viz. ſupplying chiefly the ſockets of the teeth; whence it is named ARTERIA ALVEOLARIS. It is an artery fully as large as that of the lower jaw; it begins upon the back of the antrum Highmorianum, and runs round that tuberoſity towards the face and cheek with very tortuous branches. Its branches are diſtributed firſt to the buccinator and fat, which fills up the great hollow under the cheek-bone, and alſo to the cheek-bone itſelf, where it is connected with the jaw-bone. Secondly, Other branches perforate into the antrum Highmorianum by ſmall holes, which are eaſily ſeen upon its back part or tuber, and ſome of theſe branches go into the ſockets of the backmoſt teeth. Thirdly, A more important branch than any of theſe, the branch indeed from which it has its name of alveolar artery, enters by a hole into the ſubſtance of the jaw-bone, and goes round in the canal of the teeth juſt as the artery of the lower jaw does, giving branches to each ſocket. The curlings of this artery upon the back of the antrum are very curious; and while its deeper artery furniſhes the teeth, ſome of the ſuperficial branches go to the gums.

8. The INFRA-ORBITAL is ſo named from the hole or groove by which it paſſes all along under the eye,

from the back of the noſtril till it emerges upon the face. The infra-orbital, and the branch laſt deſcribed, viz. the alveolar artery, generally come off from the maxillary by one common trunk; the alveolar goes forwards and downwards by the back of the antrum; the infra-orbital mounts upwards, and enters the ſpheno-maxillary hole, or rather it comes off juſt at the ſpheno-maxillary hole, which is the great ſlit at the bottom of the eye. As the artery enters its proper canal at the bottom of the eye, it gives ſome twigs to the perioſteum and to the fat of the ſocket; as it paſſes along its canal in the bone, one branch dives down into the antrum through the bone; for this plate of bone in which its groove runs, is at once the floor of the eye and the roof of the antrum; within the ſocket it gives twigs alſo to the deprimens occuli, and to the lower oblique muſcle, to the lachrymal ſac, or even to the noſtrils; when it emerges from the ſocket by the infra-orbitary hole, it terminates in the levator labii and levator anguli oris, and in inoſculations with the arteria buccalis, labialis, and eſpecially with the naſal branch of the occular artery. This infra-orbitary artery is accompanied through the canal, and out upon the face, with a ſmall nerve of the ſame name, viz. the infra-orbitary nerve.

After this the maxillary, though nearly exhauſted, ſtill ſends out three ſmall arteries, in which it terminates irregularly, ſometimes one, ſometimes another twig being larger. Of theſe three, one goes to the palate, one to the pharynx, one to the noſtrils.

9. The UPPER PALATINE ARTERY ariſes near the infra-orbital; and from that point, viz. the ſpheno-

directly forwards through the ſubſtance of the parotid gland, mounts before the ear; and as it paſſes alternately the parotid gland, the face, the ear, it gives its three chief branches to theſe parts, and ends in that temporal artery which runs along the ſide of the head under the ſkin, which we feel, and even ſee diſtinctly, beating, and which we open when bleeding in the temples is required.

The temporal artery is named SUPERFICIAL, becauſe of its lying under the ſkin only, above the faſcia of the temporal muſcle, while the deep branches from the maxillary artery lie under the muſcle.— The temporal artery paſſes juſt before the meatus auditorius, and behind the branch of the jaw-bone; it puſhes its way through the ſubſtance of the parotid gland, and there it gives its firſt branches, commonly ſeven or eight in number, but quite irregular, into the ſubſtance of the gland itſelf; next it gives off to the face an artery of very conſiderable ſize; which ariſes from the ſame part of the artery with theſe parotideal branches, viz. under the zygoma and within the gland: like them it goes off almoſt at a right angle, and is like one of them, but larger, nearly of the ſize of a crowquill; it puſhes ſidewiſe through the ſubſtance of the parotid, emerges from it upon the face juſt below the cheek-bone; runs acroſs the cheek in the ſame direction with the parotid duct; it is named from this direction TRANSVERSALIS FACIEI. Its branches go to the joint of the jaw-bone, the maſſeter, buccinator, parotid gland, &c. and terminate in inoſculations with all the arteries of the face.

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Next the temporal artery, as it riſes towards the zygoma, and of courſe approaches the angle of the jaw, gives an artery which is proper to the articulation of the jaw. This artery belonging to the joint of the jaw is often named ARTERIA ARTICULARIS. After having ſent its two branches to the articulation of the jaw, it ſends another artery to the ear, which divides into two twigs; one of them going round the back part of the ear, aſſiſts the branch of the ſtylo-maſtoid artery in forming the little circular artery of the tympanum; while another branch, penetrating through the ſlit which is in the articulation of the lower jaw, goes to the muſcle of the malleus.

But before it reaches the zygoma, the temporal artery gives another branch, which is named the MIDDLE TEMPORAL ARTERY, to diſtinguiſh it from the deep temporal arteries which lie under the whole thickneſs of the temporal muſcles, and the ſuperficial temporal, which lies above the faſcia; for this middle temporal artery lies under the faſcia: but on the outſide of the muſcle it ariſes from the main artery juſt under the zygoma, riſes over the zygoma, and then pierces its way under the faſcia of the temporal muſcle, and under that covering gives branches to the temporal muſcle, the artery itſelf ſtill riſing and paſſing obliquely forwards towards the outer corner of the eye, where one of its twigs often goes to the orbicularis oculi, and inoſculates with the ophthalmic artery.

About this point, or rather above the zygoma, the temporal gives off thoſe ſmall arteries, irregular in number, which are named ANTERIORES AURIS, the anterior arteries of the ear, and which play all round the fore part of the ear.

The temporal artery having now emerged from the parotid gland, and from the thick faſcia which covers it, makes a ſudden ſerpentine turn before the ear; and then riſing about half an inch perpendicularly, it forks with a pretty wide angle into two arteries, which are named the anterior and poſterior temporal arteries. Theſe lie quite ſuperficial under the ſkin, above the faſcia, and are diſtributed in this manner: Firſt the ANTERIOR TEMPORAL ARTERY goes directly forwards to the naked part of the temple, runs up the ſide of the forehead with a very ſerpentine courſe; it is here that in old men we ſee its contortions and pulſation very diſtinctly; it goes round arching forwards and upwards from the temple towards the top of the head. It belongs chiefly to the ſkin and frontal muſcle, and that tendinous kind of ſheath which covers the cranium; it gives ſome branches to the orbicular and corrugator muſcles; it forms often a ſuperciliary arch with the proper frontal artery; it often ſends off a branch very early towards the outer corner of the eye, which is entirely deſtined for the orbicularis oculi.

The POSTERIOR TEMPORAL ARTERY is the laſt branch of all. It arches backwards over the top of the ear; it turns thus backwards till it meets the branches of the occipital artery; it deals its branches from either ſide upwards and downwards, i. e. towards the ear, and towards the top of the head in great profuſion, till it is quite exhauſted. Theſe branches belong to the ſkin chiefly and to the pericranium;

and

and the ſmaller twigs pierce the outer tables of the ſkull, and go into the bone in great profuſion for its nouriſhment.

CONCLUSION.

It would ſurely be wrong to conclude the deſcription of a ſyſtem of arteries ſo important as this, without attempting to intereſt my reader in this piece of anatomy, by obſerving a few anatomical and ſurgical facts.

That arteries are not tortuous to favour the extenſion of parts, but rather becauſe they have been extended and long puſhed by the current of blood, is a fact very manifeſt to any one who conſiders the condition of many of theſe arteries which I have juſt deſcribed. When we firſt obſerve the thyroid, lingual, and labial arteries; when we conſider that the tongue, the throat, the lips, are moveable and dilatable parts—we are apt to ſay that ſuch arteries are tortuous to favour thoſe motions. But when we remark the curling form of the alveolar artery, where it lies againſt the back of the antrum; of the occipital artery, where it lies firm againſt the bone; of the temporal, where it riſes along the ſide of the head—we perceive clearly that this curling has nothing to do with dilatation. And Dr. Hunter's obſervation of the arteries of the womb being tortuous, to allow of extenſion, is not like the obſervation of ſo great an anatomiſt, but of one who had not conſidered many of the chief arteries e body: For the womb itſelf has its arteries more uous at the end of pregnancy than at its com- cement; and the ſtomach, the bowels, the blad- although they ſuffer greater and more ſudden ntion than the womb, have arteries which are ſtraight in their courſe. Are there any curling ries in the muſcles which contract to one half r diameter? are there any in the joints which t and bend ſo freely? are there any curling arte- in the whole ſyſtem of a child? are there any ries in the whole ſyſtem of an aged perſon which t this tortuous form? In ſhort, this tortuous n has no relation to the dilatation of the parts: s merely a conſequence of the long continued ſure of the blood: it is this only that can account the ſlowly increaſing tortuoſity in the temples or ds of an old man, or the ſudden tortuoſity which newly dilated artery aſſumes after the operation aneuriſm.

ext it is natural to obſerve, as a thing which may ent confuſion in the ſtudent's mind, how irregu- (after all our attempts at arrangement) the ſmaller ries unavoidably muſt be; how natural it is that a particular part ſhould draw its blood from all arteries which are near or round it. The ear has oſterior artery peculiar to itſelf; but it has alſo anterior artery from the temporal, where it lies er the parotid gland; and it has even a ſuperior s from that branch of the temporal artery, which ds round towards the occiput, and arches over the The dura mater has its great middle artery ap- priated to itſelf, a peculiar branch, the firſt of the maxillary artery; but it has beſides ſmall aſſiſting arteries, entering by almoſt every point at the baſis of the ſkull; and eſpecially it has arteries from the maxillary, by the mouth of the Euſtachian tube, from the pharyngeal, running in by the hole for the great jugular vein; and from the occipital both by the hole of the jugular vein in the baſis of the ſkull, and alſo by the ſmall occipital hole in the back part of the ſkull, cloſe by the temporal bone. The throat alſo, though it has many peculiar arteries, derives its branches from a great many ſources; as from the lingual artery by twigs, which croſs the root of the tongue; from the labial artery by branches, which go to the tonſil tongue, and palate; from the pharyngeal artery many branches not confining themſelves to th pharynx, ſtretch forwards to the palate, tongue, and tonſils; and, laſtly, the maxillary artery gives a profuſion of branches to all parts of the throat. Theſ may ſerve as hints by which the ſtudent, if he wiſhe to become a correct anatomiſt, may trace the inoſculations; or for the ſurgeon, if he wiſhes to ſeparate th ſtudy of this minute anatomy from that of the greate arteries.

The ſurgeon's intereſt in underſtanding theſe arteries is, indeed, very ſtrong. It were impoſſible t enumerate all the various occaſions on which thi piece of anatomy may be uſeful; but, ſurely, one ma eaſily ſay enough on this ſubject to attach the youn ſurgeon to the diligent ſtudy of theſe arteries.

Among the various motives for diligence, I woul mention theſe; the terrible hæmorrhagies which he i daily called to ſtop, when ſuicides, though they hav not cut the carotids, have cut the great arteries of the thyroid gland; the neceſſity of thinking about the tumours of the gland itſelf, for I have had the unhappineſs to ſee a perſon periſh by ſuffocation while conſulting phyſicians forbade any operation; and I had no other than the melancholy privilege of watching, for many hours, the laſt ſtruggles of a perſon, who had the day before been walking through all the rooms in tolerable eaſe and health. Could nothing have been reſolved on? Muſt we always ſubmit to this? Might not an inciſion in the fore part (where few arteries are) have at leaſt uncovered the trachea, given a temporary relief, and made the tumor ſuppurate more freely? The extirpation of the tongue, which is mentioned with horror, would be a leſs terrible operation to one acquainted with theſe arteries; the extirpation of all tumours under the jaws is dangerous; the cutting out completely the parotid gland is a thing quite impoſſible, ſince the greateſt of all the arteries, viz. the temporal and the maxillary, lie abſolutely imbedded in the gland. What ſhall we think, then, of thoſe ſurgeons who talk in ſuch familiar terms of cutting out the parotid gland? Bleedings from the noſe have been ſo often fatal, that Petit is celebrated to this day for a diſcovery which he never made, viz. the way of plugging the noſe ſo as to ſtop this bleeding. Have not the French Society been buſy renewing inventions for ſecuring even ſo ſmall an artery as that of the dura mater? In the hair-lip operation, in cutting cancers, in diſſecting tumours from all parts of the face, the ſurgeon commands the blood only by knowing theſe arteries. Cowper, the celebrated ſurgeon and anatomiſt, had his head ſo full of this project, that inſtead of waiting for hæmorrhage during his operation, he cut off two days before the chief ſource of the blood. He was going to cut out the parotid gland; and two days before he placed a ſmall button of cauſtic on each ſide of the labial artery, where it lies upon the cheek, paſſed a ligature under it, tied it firm, and then proceeded to his operation next day. But this great anatomiſt made at one ſtroke two grievous blunders: he miſſed, for want of knowledge, the chief arteries of the parotid gland, for they come from the temporal artery; and, if I miſtake not, he had tied the vein, for moſt aſſuredly it is the faſcial vein which he is deſcribing in his twelfth table from Bidloo. How terrible the extirpation of tumours from the gums, throat, tonſils, &c. I need not ſay; where the ſurgeon always uſes burning irons inſtead of needles, where not unfrequently the patient dies.

SECT.

SECT. II.

OF THE ARTERIES OF THE BRAIN, SPINAL MARROW, AND EYE.

§ I. OF THE ARTERIES OF THE BRAIN.

THE INTERNAL CAROTID ARTERIES are named the ARTERIÆ CEREBRI, as being the chief arteries of the brain; while, in truth, the brain is alſo ſupplied by two other arteries nearly equal in ſize, viz. the vertebral arteries, which, though they do indeed ariſe from a different trunk, viz. the axillary artery, yet are ſo entirely deſtined for the brain, give ſo few branches before they reach the ſkull, are ſo important when they arrive there, and above all make ſo large a communication with the carotid arteries, that without a deſcription of the vertebral arteries, any deſcription of the carotids muſt be defective; they unite ſo with the carotids as to form but one great ſyſtem of veſſels for ſupplying the brain.

The two greateſt functions of the animal body, thoſe of the womb and of the brain, the one for the life of the individual, the other for the continuation of the ſpecies, are the moſt liberally ſupplied with blood. The womb has on each ſide two arteries; it has two ſpermatics, and two hypogaſtrics, and the inoſculations of theſe veſſels are very large and free. The brain has two great arteries on each ſide; it has two carotids, and two vertebral arteries; they are infinitely larger than thoſe of the womb; their inoſculations are ſo particular, that there are no others like them in all the body: the injection of any one artery eaſily fills the whole; the preſervation of but one artery ſaves the life of the creature, when the others are ſtopped.

Theſe four arteries alone convey to the head the fifth part of the whole maſs of blood. This is the calculation of the older authors; and even thoſe who would ſettle it at the loweſt point ſtill acknowledge that the carotid and vertebral arteries receive at leaſt the tenth part of all the blood of the body. The brain then, which weighs not a fortieth part of the whole body, receives one tenth of all the blood; a proportion which muſt occaſion ſurpriſe.

Beſides the profuſion of blood which thus ruſhes into the brain, the impetus with which it forces its way ſeems dangerous; and Nature alſo ſeems to have provided againſt the danger. We cannot be but ſenſible of this danger; for the ſlighteſt increaſe of velocity occaſions ſtrange feelings, if not abſolute pain. We cannot run for any length of way, nor aſcend a ſtair rapidly, nor ſuffer a paroxſm of fever, nor in ſhort have the circulation quickened by violent exertions, by emotions of the mind, or by diſeaſe, without feeling an alarming beating within the head; we feel it cularly in the carotid canal where the artery s through the bone. If it continue from diſ- or if we perſiſt in our exertions, giddineſs, neſs, ringing of the ears, come on. Haller re- bers, that while he was lying in a bad fever, he ed ſo much from the pulſations of the carotid y within the ſkull, that his head was lifted from illow at every ſtroke. I wiſh he had ſaid, "ſeemed lifted from his pillow at every ſtroke;" for it rather a ſickly feeling than what could actually en.

id this vaſt column of blood ruſh directly into the , we do not know what might be its effects; but y they could not be harmleſs, ſince Nature has ided againſt it in Man, and in the lower animals h hang their heads, with a peculiar care. In Man, blood is retarded chiefly by the tortuous courſe h the artery is obliged to follow, and by that bony canal which, by holding the carotid as in ath, muſt ſuppreſs its violent action, and at leaſt ent its being dilated by force of the blood, when, ften happens, the lower part of the artery is more and tenſe. Perhaps alſo it may have ſome effect, the carotid, as it lies by the ſide of the ſella tur- , is not naked and free, but is incloſed in a venous s, which conſiſts of cells like thoſe of the male s, and in the heart of which the carotid lies ed in the blood.

is alſo peculiar in all the arteries of the brain, that do not enter in trunks into its ſubſtance. This ns ſo be a violence which the ſoft texture of the brain ld not bear; but all the arteries having perforated the dura mater, attach themſelves to the pia mater, a delicate membrane, which is the immediate covering of the brain; which follows all its diviſions, lones, and convolutions; which enters all its cavities, and lines its internal ſurfaces as it covers the external To this membrane of the brain the arteries attach themſelves: it conducts them everywhere along the ſurface of the brain, and into its cavities; and when the arteries are to enter into the ſubſtance of the brain, they have already branched ſo minutely upon the pia mater, that they enter into the pulpy ſubſtance in the moſt delicate twigs; ſo that having injected the brain, at whatever level you cut into it, you find its white ſurface dotted with red points regularly, and like the dots of a pin.

But in the lower animals, eſpecially in the Calf, the Deer, the Sheep, which hang their heads in feeding, there is a proviſion of ſo ſingular a nature, that we can have no doubt that theſe contortions of the great trunks and minute diviſions of the ſmaller arteries in Man have the ſame final cauſe; for in thoſe creatures the carotid, before it enters the brain, firſt divides into innumerable ſmaller arteries. Not one of theſe is ſent off for any particular function: they are immediately reunited again, and gathered together into one trunk; and then the force of the blood being thus broken, the artery divides a ſecond time into branches of the ordinary form, which enter ſafely into the ſubſtance of the brain.

It is ſtill further ſuppoſed, that the arteries of the brain have this peculiarity, diſtinct from all others in the body, that as they enter the ſkull they lay aſide one of their coats, and that of courſe the arteries of the brain are peculiarly weak. That the arteries of the brain want that outward coat of cellular ſubſtance which all arteries paſſing through other cavities or along the limbs have, is no doubt true, and ſo far they are thinner: but how much they are weakened by this loſs, it is not eaſy to ſay; for they want none of the coats which are eſſential to the conſtitution of an artery; and this cellular coat, though it conſtitutes much of the thickneſs of an artery, has, I believe, but little to do with its ſtrength. Yet true it is, that the arteries of the brain, either from being weaker in themſelves, being leſs ſupported, lying upon the ſoft and pulpy ſubſtance of the brain, are more frequently burſt by falls, or even by the ſlighteſt accidents, than the arteries of any other part, even the limbs, however much expoſed. Our injections burſt them very often; the ſlighteſt blow or fall upon the head often produces an internal effuſion of blood, which occaſions death; but that the arteries of the brain are ſo delicate as to be burſt by a falſe ſtep, ſo as to produce a fatal aneuriſm within the brain, is a truth perhaps not commonly known.

A young woman, carrying in her arms her firſt child, about ſix months old, ſlipped her foot with a ſlight ſhock; but it was on plain and even ground, and ſhe did not fall down. In the inſtant of this ſhock ſhe was ſenſible of a ſudden pain in the right ſide of her head: it was ſo peculiar, that ſhe ſaid ſhe could cover the point with her finger; and though ſlighter at intervals, this pain never left her to the moment of her death. She walked home, went about her little family-matters, ſuckled her child; but was ſeized that evening with ſickneſs, not violent like that of any ſudden diſeaſe, but rather like the eaſy vomiting of a pregnant woman.

She continued very ſick, with ſlight headach; but ſtill was out of bed all day long, went about her houſehold affairs, and had no ſymptom which could lead one to ſuſpect her very dangerous condition, or what a dreadful accident had happened. She got up during the night after this accident for ſome cool drink, felt herſelf extremely giddy, was obliged to ſupport herſelf by a cheſt of drawers which ſtood by her bedſide, and went to bed again immediately. On the evening of the ſecond day ſhe got out of bed, made tea as uſual, was out of bed during the evening, had no complaint, except the continual ſickneſs, ſlight pain of the head, and giddineſs ſtill ſlighter. That night ſhe expired. Her pulſe all along had beat low and weak, and never more than 60 in the minute.

When I was brought to open the body, I heard nothing of the pain of her head, though it was fixed and conſtant, and without that nothing could be more puzzling than this combination of circumſtances. Firſt, the ſudden ſlipping of her foot, and the inceſſant ſickneſs which enſued, ſuggeſted the idea of hernia; but no ſuch ſecret was known among her relations; and upon opening the abdomen, no hernia was found, neither open nor concealed, as in the thyroid hole.

Next we were informed of a palpitation, which had been uſual with her. It appeared that ſhe had complained chiefly about the period of her firſt menſtruation, and ſome years before her marriage. It ſeemed to be hyſterical merely; but upon opening the thorax, we found the heart wonderfully enlarged and crammed with a dark and grumous blood.

But next a new ſcene opened upon us; and this enlargement of the heart appeared to ariſe like that of the liver, which ſo often accompanies fractured ſkull, from the languid action of the heart and torpor of all the ſyſtem in thoſe who lie even for a few days comatoſe.

Now, for the firſt time, I was informed that the ſhock of ſlipping her foot had cauſed a ſudden pain of the head; that it was pointed, confined to one ſingle ſpot, inceſſant, accompanied with perpetual vomiting or deſire to vomit, and with giddineſs during the night.

Upon opening the head, I found the dura mater of a moſt ſingular appearance; livid, or rather like the gizzard of a fowl, with green and changing colours. Having cut it open the pia mater appeared like red currant jelly, with freſh coagulated blood ſo firmly attached to it, that it ſeemed as if driven into its very ſubſtance and incorporated with it. Upon cutting and tearing open the pia mater, each convolution of the brain was ſurrounded and ſeparated from that next it by coagulated blood. Upon cutting into the ventricles of the brain, that of the right ſide was found to contain four ounces of entire and coagulated blood; the cavity at firſt view was like opening a ventricle of the heart; the blood, very dark and firmly coagulated, was forced out by the preſſure of the ſurrounding parts; the coagulum became gradually firmer and whiter, till it turned to a very firm ſtringy clot, which ſtuck in the mouth of the middle artery of the brain. Being carefully examined, it was found to be ſticking firm in the mouth of the artery which had burſt, as if by the ſeparation of two of its rings. The blood, which thus filled the right ventricle, had alſo made its way down in prodigious quantity into the third and fourth ventricles, quite into the occipital hole; but the oppoſite ventricle of the ſame ſide it had not filled.

The quantity of blood aſcending to the head is exceedingly great; its free circulation in all the arteries is perfectly ſecured; and the plan of its diſtribution is extremely ſimple, for the carotid entering by the os petroſum gives three branches. Firſt, A branch which unites the two carotids with the two vertebrals, and forms the fore part of the circle of Willis. Secondly, It gives an artery to the great middle lobe, whence it is named the great middle artery of the brain. Thirdly, An artery which is named anterior cerebri, as belonging to the fore part of the brain. But the vertebral, as it ariſes through the occipital hole, lies upon the cerebellum, and ſupplies all the cerebellum, and alſo the back part of the brain. One branch goes to the back part of the cerebellum, another to the fore part of the cerebullum, a third branch goes to the back part of the brain; and thus there is formed betwixt the carotid and the vertebral, by means of the great inoſculation of the circle of Willis, one great ſet of veſſels; which ſhould firſt of all be deſcribed free from all the interruptions of trivial arteries, which go off from point to point, but of which the deſtinations cannot be important, which are hardly known, which do not go in any two ſubjects the ſame way.

OF THE INTERNAL CAROTID ARTERY.

The internal carotid artery leaves the external carotid at the angle of the jaw: it is ſo inclined to contortions, that at this point it even bulges, and ſeems the outermoſt of the two. In mounting along the neck, it is tied by cellular ſubſtance to the fore part of the rectus or ſtraight muſcle of the neck, and it is alſo connected with the par vagum and intercoſtal nerve; the ganglion of the intercoſtal, or ſympathetic nerve lies by its ſide; the nerve, before it forms this ganglion, comes down ſmall and thread-like through the ſame canal by which the carotid paſſes into the ſkull.

The contortions of the carotid are great, both before and after its paſſage through the bony canal; but within the canal it is forced to particular and ſucceſſive bendings, ſuch as indicate plainly ſome deſign of Nature; for the canal for the artery is long and tortuous, while the nerves and veins paſs through plain and ſimple holes. When the carotid firſt preſents itſelf to enter the ſkull, it is curved, and is a little behind its hole; it bends forwards and inwards a little, and ſo enters the canal; in entering the canal it riſes almoſt perpendicularly upwards, but ſoon bends forwards again, lying, as it were, upon the floor of the canal; then it bends again upwards and forwards, to emerge from the canal; by which turn the portion of the artery which is engaged in the canal has the form of a Italic ſ. Even after it gets into the ſkull, it muſt ſtill bend once more ſidewiſe and forwards, as if t meet its fellow, and to get to the ſide of the ſell turcica; then it goes directly forwards till it touches the anterior clynoid proceſs; and then doubling back or returning upon itſelf, it riſes perpendicularly; an ſo perpendicular is this laſt turn, that when cu acroſs, the mouth of the artery gapes perpendicularl upwards: here it begins to give its branches to th brain.

It is by the ſide of the ſell turcica that th CAVERNOUS SINUS ſurrounds the artery. This ſinus i formed by the two plates or lamellæ of the dura mater parting from each other, and leaving an interſtice ful of cells, like thoſe of the penis or of the placenta. It i filled with blood, by communication with ſeveral o the ſmaller ſinuſes or veins about the baſis of the brain the ophthalmic veins bring into it the blood from th eye; four or five ſmall veins deſcending from the foſſ Sylvii bring blood into it from the middle parts of th brain; the ſinuſes of the os petroſum (both on its uppe and lower grooves) open into it, one high, anothe lower down, and that circular ſinus or vein which ſurrounds the root of the optic nerves opens into it from either ſide. All this blood is poured into the cells bathes the carotid artery which lies naked in it; and by the ſide of the carotid artery lies alſo that ſmal nerve of the ſixth pair which begins the great intercoſtal nerve, naked in the blood; it is tinged by the blood, and its branches retain the tinge ſome way down the neck.

Veuſſens firſt diſcovered this curious ſtructure; Ridley denied it, and Haller at laſt in his turn confirmed it. Veuſſens believed that the ſinus which depoſited this blood conveyed it away again. Haller ſays that this is the peculiar office of that vein which accompanies the carotid artery, and which is named the vena-ſodalis arteriæ carotidis. It was once ſuppoſed that certain ſmall arteries opened alſo into the ſinus; but it has neither arteries, nor pulſation.

Thus we trace the carotid through its canal, through the cavernous ſinus, up to the ſide of the ſella turcica, and about to enter the brain, to give off the arteries of the brain. But before we deſcribe theſe, it will be eaſy to count ſhortly thoſe little twigs which it gives off in the canal and in the ſinus.

The carotid artery ſeldom gives out arteries before it enters the ſkull; it is a luſus naturæ, when it does happen that the occipital or pharyngeal arteries come off from it.

The firſt twig, which in any caſe it gives off, is ſometimes a ſmall artery, which returns downwards along with the upper moxillary nerve*; next a ſmall twig, accompanied by a branch from the meningeal artery, goes into the tympanum by way of the aquæ ductus Fallopii; and next, while the artery is within the ſinus carvernoſus, it gives out two little branches, the one forwards the other backwards, named ARTERIES of the RECEPTACULUM.

1. The little artery which goes backwards from the ſinus or receptaculum goes chiefly to that part of the

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* The ſecond branch of the 5th pair.

dura mater which covers the poſterior clynoid proceſs, and which covers the cuneiform proceſs of the occipital bone; it gives twigs to the 4th, 5th, and 6th pair of nerves and to the pituitary gland; in ſhort, to all the parts at the back of the ſella turcica; it ends in inoſculations with thoſe twigs of the vertebral artery, which come off from the vertebral before it enters the ſkull.

2. The little artery which comes out from the receptaculum to go forwards, ariſes where the carotid is croſſed by the 6th pair, miſtaken for a nerve by thoſe who ſuppoſe that the intercoſtal ariſes from a branch of the 5th pair. The diſtribution of this little artery is nearly the ſame with that of the firſt, for it belongs to the 3d, 4th, and 5th pairs of nerves and to the pituitary gland.

The carotid having riſen to the anterior clynoid proceſs, gives out there a ſmall artery, no bigger than a crow-quill, which enters directly into the orbitary hole, accompanies the optic nerve into the eye, furniſhes the eye, the eyelids, the muſcles, and the lachrymal gland, and ſends out branches upon the forehead, viz. the frontal arteries in which it ends. This is a ſhort hiſtory of the OPHTHALMIC ARTERY; which, as it furniſhes all the arteries of the eye, muſt be deſcribed apart.

DIVISION OF THE INTERNAL CAROTID.

THE carotid, now about to enter into the brain, divides at the ſella turcica into three arteries; one the fore lobe, another to the middle lobe; and a rd to form the circle of Willis. Theſe arteries are ally ſo numbered that the communicating branch firſt deſcribed, next the anterior artery of the in, and laſtly the middle artery of the brain. But this arrangement no one who is accuſtomed to ob- e the courſe of this artery can entirely approve; for n the carotid riſes from the ſide of the ſella turcica, vides into its three branches all at once, in a tripod- form: the middle branch of the tripod is largeſt; next, which goes forwards to the fore lobe of the n, is ſmaller; the third, which is the communica- branch, going backwards to unite with the verte- artery and form the circle of Willis, is the ſmalleſt ll. The middle artery of the brain then is, from reat ſize, to be regarded as the trunk.

I. ARTERIA MEDIA CEREBRI.

HE middle lobe of the brain is ſeparated from anterior lobe by a very deep ſulcus or furrow, ch is named FISSURA SYLVII. This fiſſura Sylvii is ned by the tranſverſe proceſs of the ſphenoid bone, in other words, by that very ſharp line which runs laterally from each of the clinoid proceſſes, and ch parts the fore lobe, which lies in the ſhallow of the ſkull upon the orbitary proceſſes of the tal bone, from the middle lobe, which is the eſt of all, and lies in the deepeſt part of the ſkull ind the clynoid proceſſes. The MIDDLE ARTERY OF BRAIN having riſen from the ſide of the ſella tur- , runs ſtraight along this foſſa Sylvii, and is really the continued trunk of the carotid; it is larger than the artery at the wriſt; it goes directly outwards, viz. towards the temple; it runs along the foſſa Sylvii, and is lodged deep in that cleft; where it lies deep, it divides into two great branches, one deep and one ſuperficial; it gives ſome branches to the anterior lobe, but it is chiefly limited to the middle lobe of the brain; its branches to the poſterior lobe, or inoſculations with any branches of the baſilar artery, are comparatively few.

Thus the artery ends by paſſing into the ſubſtance of the brain. But nearer the ſella turcica and before it enters into the foſſa Sylvii, it gives ſome ſmall and delicate arteries; the conſideration of which ſeems to be unimportant at firſt view, but which is really uſeful in explaining the anatomy of the brain. It gives ſmall twigs to the pituitary gland, to the optic nerve, to the tentorium, and eſpecially to the pia mater covering the baſis of the brain. Among theſe ſmall twigs certain ſets of arteries make a very diſtinguiſhed figure.

1. There is one ſmall artery which runs up into the anterior horn of the lateral ventricle, and forms that great plexus which lies along the floor of the ventricle, named PLEXUS CHOROIDES. This, then, is the ARTERY of the CHOROID PLEXUS.

2. There is a ſet of arteries, of conſiderable number, but varying in reſpect of number, ſmall as ſewing threads, which inoſculate repeatedly with each other, and which are ſcattered widely and beautifully over the crura cerebri and baſis of the brain, forming in the pia mater a plexus or web of veſſels. This part

of the pia mater is named velum from its beauty and delicacy; and this is what Wepfer, among other older authors, conſidered as a ſpecies at leaſt of the rete mirabile: but that name implies a peculiar office, as in beaſts, which this delicate net-work of veſſels cannot have.

2. ARTERIA ANTERIOR CEREBRI.

THE FORE ARTERY of the BRAIN comes off from the middle artery at right angles nearly; for the great or middle artery runs directly outwards towards the temple, while this ſecond artery runs directly forwards along the fore lobe of the brain. It is named ſometimes the artery of the corpus calloſum, becauſe that of two great branches into which it is divided one goes to that part of the brain. The corpus calloſum (a moſt abſurd name for any part of the brain) is the white and medullary ſubſtance where the two hemiſpheres of the brain are joined; and upon ſeparating the two hemiſpheres with the fingers, the corpus calloſum is ſeen like a large white arch, and the artery of the corpus calloſum is ſeen alſo arching over its ſurface.

The anatomy of the arteria anterior cerebri may therefore be explained thus: Firſt it goes off at right angles from the middle artery of the brain, which is to be conſidered as the trunk, and there it often gives ſmall twigs to the olfactory and optic nerves: next the two anterior arteries of each ſide, while they go forwards as if towards the criſta galli, bend a little towards each other; they almoſt meet, but do not abſolutely touch; they form a communication with each other, which of courſe is exceedingly ſhort, but pretty large. It is this ſhort communication which completes the circle of Willis at its fore part. This croſs communication betwixt the arteries of the oppoſite ſides paſſes juſt before the ſella turcica and pituitary gland, and exactly in the middle it ſends off an artery, which goes down into the third ventricle, and gives branches to the fore part of the fornix and to the ſeptum lucidum.

After this communication, both arteries riſe, with a large ſweep along the flat ſurface of that deep diviſion which the falx makes betwixt the two hemiſpheres of the brain; there each divides into its two great branches; one attaches itſelf to the corpus calloſum, or that arch which we ſee upon holding apart the two hemiſpheres; it arches along with the corpus calloſum ſo as to deſcribe a ſemicircle; it is the larger of the two branches; it is named ARTERIA CORPORIS CALLOSI: the other branch keeps upon the flat ſurface of the brain, where the one hemiſphere lies flat upon the other, and it riſes in a beautiful arch within the pia mater, dividing into beautiful and very minute ramifications before it enters actually into the ſubſtance of the brain.

Theſe two great branches of the anterior artery are well diſtinguiſhed by Wepfer by the names of arteria profunda and arteria ſublimis (the deep and ſuperficial of the anterior artery), as there is a deep and a ſuperficial branch of the middle artery. The arch of the arteria anterior cerebri overhangs in a manner that of the artery of the corpus calloſum, and both of

them

em inoſculate under the falx with the arteries of the poſite ſide.

3. ARTERIA COMMUNICANS.

THE COMMUNICATING ARTERY goes as directly ackwards from the middle artery as the anterior arery goes forwards. It is ſmall, proceeds backwards, nd a little inwards; it goes round the ſides of the orpora mamillaria, and is about a quarter of an inch n length before it meets the vertebral artery; and hough it does give off ſmall twigs, as to the infundibulum, to the optic nerve, to the crura cerebri, and ſpecially one of greater ſize, to the choroid plexus; yet ll theſe are trivial arteries, ſuch as every trunk at the baſis of the brain gives off. It is not its twigs that are to be obſerved, but itſelf only that is important, as forming one of the largeſt and moſt important inoſculations of the body. It unites the middle artery of the rain, which is the trunk of the carotid, with the oſterior artery of the brain, which is the firſt and reateſt branch of the vertebral artery.

This anaſtomoſis is the circle of Willis, too rearkable not to have been very long obſerved; it as drawn by Veſlingius and by Caſſerius; it is but l repreſented by Bidloo and by Cowper; it is not circle, but is right lined, and of courſe angular: it of very unequal ſize; in one body it is large, in nother ſmaller, often even in the ſame body; it is regular, the one ſide being large and the other mall.

This inoſculation brings us round to the firſt of the ertebral arteries, viz. the ARTERIA POSTERIOR CERE-

BRI; for the vertebral artery gives two arteries to the cerebellum, and one to the back part of the brain.

OF THE VERTEBRAL ARTERY.

THE vertebral artery, though but the ſecondary artery of the head, is a principal one of the brain, and conveys a very great proportion of blood; and its turnings and windings before it enters the ſkull are almoſt as particular as thoſe of the carotid itſelf. The vertebral is among the firſt branches of the axillary artery, and comes off from it where it lies acroſs the root of the neck. The two lower ganglions of the ſympathetic nerves lie over it, and their threads ſurround its trunk, making curious net-works round it. The artery then enters into the canal prepared for it in the tranſverſe proceſſes of the vertebra, commonly getting in by the 6th vertebra: but in this it is irregular, ſometimes entering into the 7th or loweſt; and it has been ſeen entering into the uppermoſt hole but one. In this canal it aſcends in a direct line from the bottom of the neck to the top; but like the carotid it makes great contortions before it enters the ſkull; for when it has reached the ſecond vertebra, its tranſverſe proceſs being rather longer than thoſe of the lower vertebræ, the artery is forced to incline outwards; and the tranſverſe proceſs of the atlas or firſt vertebra being ſtill much longer, the artery in paſſing through it is carried ſtill farther outwards;

wards; it is forced to make a very ſudden turn, and is quite expoſed. When the artery has paſſed through the tranſverſe proceſs of the atlas, it makes another very ſudden turn, lies flat upon the circle of that vertebra, ſo as to make a large hollowneſs or groove upon the bone, and then it enters the foramen magnum by riſing in a perpendicular direction; and then again it bends and inclines forwards, laying flat along the cuneiform proceſs of the occipital bone, where it ſoon meets its fellow, and the two uniting form the baſilar artery.

This baſilar artery lies, with regard to the bone, upon the cuneiform proceſs of the os occipitis, and runs along it from the foramen magnum to the ſella turcica: with regard to the brain, it lies upon that great tubercle which is named the tuber annulare or pons Varolii; as it lies upon the tuber annulare, it marks it with a large furrow; and as it goes along in one great trunk, it gives out from each ſide little arteries, which belong to this tuber annulare. Theſe alſo make ſmaller furrows on it ſurface.

The vertebral artery has, like the carotid, its three great branches.

I. ARTERIA CEREBELLI POSTERIOR.

THE POSTERIOR ARTERY, OF LOWER ARTERY of the CEREBELLUM, is ſmall and not regular. It comes off from the baſilar artery either immediately after the union of the vertebrals, or from the vertebral artery immediately before the union. It is often ſmaller on one ſide than on the other, and ſometimes it is wanting on one ſide. It moves downwards in a ſort of retrograde courſe betwixt the acceſſory nerve of Willis and the group of fibres which form the eighth pair; and dives in betwixt the cerebellum and the medulla oblongata. Its larger branches ſpread out upon the pia mater, and then enter into the medullary ſubſtance. They belong to the cerebellum, to the ſpinal marrow, and ſome of them to the pons Varolii. But there are alſo ſmaller and particular twigs, as twigs to the eighth and ninth pairs of nerves: one alſo which enters into the fourth ventricle, to form a ſort of velum or choroid plexus there: and as this poſterior artery winds downwards under the cerebellum, it gives many branches about the vermis, and ſmall twigs which run betwixt the lower point of the pons Varolii and the pyramidal bodies.

Next the ARTERIA BASILARIS proceeds forwards along the pons Varolii in one great trunk: now the pons Varolii is juſt the tuberoſity produced by the crura cerebri and cerebelli, meeting and uniting to form the ſpinal marrow. The corpora olivaria and pyramidalia are juſt two bulgings at the root of the ſpinal marrow; and as every great artery, whatever its deſtination may be, gives twigs to thoſe parts which it paſſes over, ſo does the baſilar artery; giving twigs firſt to the corpora olivaria and pyramidalia, next to the crura cerebelli and to the crura cerebri; and as it runs along the pons Varolli it diſtributes little arteries to it from right to left. Theſe little arteries alſo mark the ſides of the pons with ſmall furrows, which are ſeen when the arteries are diſſected away. One of theſe tranſverſe arteries, longer than the reſt, looks like another poſterior cerebri. It goes to the ſeventh pair, or auditory nerve, in the following way: The ſeventh pair of nerves proceeds from the back part of the pons Varolii; and as it goes forwards, the two nerves which it conſiſts of, viz. the portio dura and the portio mollis, are ſeparated from each other by a ſmall and very beatiful artery which ſhoots in betwixt them, and enters along with them into the ear. The baſilar artery alſo gives twigs to the fifth and ſixth pairs of nerves, which ariſe from the fore part of the pons, as the ſeventh pair ariſes from behind.

Arrived at the fore part of the pons Varolii, the vertebral artery gives off almoſt at one point four great arteries, two to the right hand and two to the left, Theſe are the anterior cerebelli and the poſterior cerebri,

2. ANTERIOR CEREBELLI.

THE ANTERIOR ARTERY of the CEREBELLUM, or the upper artery as it is called, goes off at right angles from the baſilar artery, and bends round the crura cerebri to get to the cerebellum. It gives its branches firſt to the crura cerebelli, to the cerebellum, and to the vermis. Secondly, There is a greater artery going over all the upper part of the cerebellum, (where it lies under the brain), and alſo another which keeps cloſer to the brain than to the cerebellum, branches over that velum or delicate part of the pia mater which is interpoſed betwixt the cerebellum and brain; and going along it ſupplies the crura cerebri, and arrives at laſt at the place of the nates, teſtes, and pineal gland, and attaches itſelf to them. Some of the twigs go down into the fourth ventricle.

3. ARTERIA POSTERIOR CEREBRI.

THE POSTERIOR ARTERY of the brain goes off immediately after this, is like it, runs parallel with it, is larger, goes to the poſterior lobe of the brain, and receives near its root the communicating artery from the carotid, which forms the circle of Willis. Where this poſterior cerebri and the anterior cerebelli run parallel with each other, the third pair of nerves riſes betwixt them. The poſterior cerebri firſt gives a ſmall twig on either ſide to the bottom of the third ventricle, which runs ſo far forwards as to give branches to the thalami, centrum geminum, infundibulum, and to the crura fornicis. Then the main artery bending like that laſt deſcribed round the crura cerebri, and paſſing deep into the great diviſion betwixt the cerebellum and brain, arches upwards towards the back lobes of the brain; but before it arrives there, it gives firſt ſmall twigs to the crura cerebri, and then another notable artery (though ſmall) deſtined for the internal ſurfaces of the ventricles. This is a chief artery of the choroid plexus; it enters the lateral ventricle by the poſterior horn; goes along with the cornu amonis; helps to form the choroid plexus; inoſculates, of courſe, with the choroid arteries from the carotid; and twigs alſo go from this artery to the nates, teſtes, and pineal gland, or in other words, to the velum which ſeparates the cerebellum from the brain, which cloſes the ventricle behind, and which covers the pineal gland, and is a membrane or velum to it alſo; the pineal gland, nates, and teſtes, being ſituated neither in any of the ventricles, nor on the ſurface of the brain, but betwixt the ſurfaces of the brain and cerebellum, where the one lies upon the other.

After this ſecond branch to the internal ſurfaces, the great trunk of the poſterior cerebri branches profuſely like a tree all over the back part of the brain, inoſculating forwards with the middle artery of the brain, and alſo with the artery of the corpus calloſum.

Thus is the whole brain ſupplied with blood; and next in order come the arteries of the ſpinal marrow.

§. 2. OF THE ARTERIES OF THE SPINAL MARROW.

I HAVE mentioned none of thoſe ſmaller arteries which the vertebral gives off before entering the ſkull, becauſe being deſtined chiefly for the ſpinal marrow they belong to this ſecond claſs.

The vertebral artery, as it mounts along its canal towards the head, gives at each ſtep, or as it paſſes each vertebra, a delicate twig; theſe little arteries paſs through the intervertebral ſpaces, go to the deeper muſcles of the neck, and inoſculate with the thyroid and cervical arteries. In like manner, other ſmall arteries go inwards to the ſpinal marrow at the place where each nerve comes out. They enter into the ſheath of the ſpinal marrow, and inoſculate with the chief arteries of the medulla ſpinalis.

As the vertebral paſſes through the atlas, both above and below that bone it gives out much larger arteries to the muſcles, as to the recti, trachelo-maſtoideus, and complexus, inoſculating largely with the occipital artery: often there is at this point one large and particular artery going out to the back of the neck.

Again, as the vertebral paſſes through the occipital hole, it gives out a little artery, which accompanies the trunk itſelf up through the foramen magnum, and goes to that part of the dura mater which covers the cuneiform proceſs, and there it inoſculates with the twig of the carotid, which enters along with the jugular vein. This is the poſterior artery of the dura mater.

Next come the arteries of the ſpinal marrow, the anterior of which comes out from the trunk of the vertebral artery; the poſterior (though it alſo ſometimes comes off from the vertebral before the baſilar is formed) more commonly comes off from the poſterior cerebelli.

1. ARTERIA ANTERIOR MEDULLÆ SPINALIS.

The anterior artery of the ſpinal marrow is the larger of the two. It was diſcovered firſt by Willis; it had been looked upon, till the time of Veuſſens, as a nerve accompanying the ſpinal marrow; becauſe, when empty of blood and uninjected, it is white, and not unlike a nerve. This ſpinal artery begins within the ſkull by two branches, which unite as they proceed down the ſpine. Theſe two branches ariſe one from each vertebral artery, at the very point where the vertebrals are about to unite to form the baſilar trunk: each artery paſſes down its own ſide of the ſpinal marrow, betwixt the corpora olivaria and the corpora pyramidalia; each artery, before it leaves the ſkull, gives twigs to the tuber annulare, and to the pyramidal and oval bodies, for they are the beginnings of the ſpinal marrow; and ſoon after emerging from the ſkull *, the two ſpinal arteries join ſo as to form one anterior ſpinal artery. This joining is uſually at the top of the neck, or rather within the ſkull, but ſometimes ſo low as the laſt vertebra of the back. Almoſt always they join within the head or near it; and the anterior ſpinal artery which they form deſcends along the ſpinal marrow in a furrow which it forms for itſelf. The peculiar office of this artery is to ſupply the ſpinal marrow and its ſheath, which it does by ſending continual branches into the ſubſtance of the ſpinal marrow; while other branches go into the ſheath itſelf, and paſs out from the ſpinal canal along with thoſe nerves which go out from the ſpinal marrow, ac-

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* The artery which accompanies the ninth pair or lingual nerve, often comes from the anterior ſpinal artery.

companied by little proceſſes of the ſheath, which are named proceſſi denticulati.

But this artery, being extremely ſmall, would be ſoon exhauſted, were it not reinforced with ſmall arteries coming into the ſheath: theſe paſs through the vertebral interſtices into the ſpinal canal, and are derived from every artery that paſſes near the ſpine. Thus in the neck the ſpinal artery receives twigs from the vertebral arteries, and from the thyroid and cervical arteries; in the back it receives twigs very regularly from each of the intercoſtal arteries, and it receives its twigs from the lumbar arteries when it has got down as low as the loins.

But this ſpinal artery which is continually diminiſhing, at laſt fails in the loins; and where the cauda equina begins, viz. in the canal of the os ſacrum, the medulla is no longer ſupplied by a ſpinal artery, but by the ſmall branches of the ſacral arteries, which enter by the ten holes of the ſacrum.

Of thoſe adventitious branches which reinforce the artery of the ſpinal marrow as it deſcends through the ſpine, each gives ſeveral other branches; they give twigs to the muſcles of the ſpine, twigs to the ſubſtance of the vertebræ themſelves, twigs to the ſheath of the ſpinal marrow; and, finally, twigs which inoſculate with the ſpinal artery, and which ſink into the nervous ſubſtance to nouriſh it.

2. ARTERIA SPINALIS POSTERIOR.

THE POSTERIOR SPINAL ARTERY differs in all eſſential points from the anterior: Firſt, There are two poſterior ſpinal arteries which ariſe, not from the baſilar or vertebral arteries like the anterior, but uſually from the arteria anterior cerebri; and they are ſmaller than the anterior ſpinal artery: Secondly, Theſe two arteries give ſmall twigs to the bottom of the fourth ventricle, and then go round from the fore to the back part of the medulla oblongata; but there, inſtead of uniting like the beginnings of the anterior artery, they continue ſeparate, run down the ſpinal marrow as two diſtinct arteries, with very frequent inoſculations betwixt them. This artery is alſo unlike the other in reſpect of its termination, for it diſappears at the ſecond vertebra of the loins. Its inoſculations with the arteries from without are very free.

§. 3. ARTERIES OF THE EYE.

THE arteries of the eye come from one branch only, the ophthalmic artery, the branch which the carotid, when it touches the anterior clynoid proceſs, ſends into the orbit along with the optic nerve. But ſmall as this original artery is (no bigger than a crow-quill), the ſyſtem of arteries which ariſes from it is very great; whether we conſider their number, the irregular parts which they ſupply, or the great inoſculations which they form even with the outward arteries of the noſe and face.

Theſe are reaſons for ſetting this order of arteries apart; and even with all poſſible care in the arrangement, it is not eaſy to deliver an orderly intelligible hiſtory of this artery. The ophthalmic artery ſupplies not only the eye itſelf, i. e. the globe, but it ſupplies alſo all the apparatus, if I may ſo call it, of the eye, i. e. the muſcles, the lachrymal gland, the eye-lids, and even the forehead and noſe.

1ſt, It ſends a great branch, which leaves the ophthalmic artery, and takes its own courſe outwards and upwards along the eye, to ſupply the lachrymal gland where it is exhauſted. 2dly, The ophthalmic ſupplies the eye itſelf, both by that artery which enters into the centre of the optic nerve, called arteria centralis retinæ, and alſo by other arteries which are named the ciliary arteries; becauſe they go onwards to the fore part of the eye, where the ciliary circle is. 3dly, The muſcles are ſupplied by an artery which comes from the ſame place nearly with thoſe ciliary arteries. 4thly, There are two arteries which go down through holes in the ſocket into the bones and cavities of the noſe; and theſe, as they perforate chiefly the æthmoid bone, are named æthmoidal arteries. 5thly, and laſtly, Thoſe arteries which go out upon the forehead and noſe are ſo directly from the trunk of the ophthalmic artery, that they muſt be regarded as the termination of it. This is the ſyſtem of veſſels which comes now to be deſcribed, and this is, perhaps, the beſt order for the deſcription.

FIRST ORDER.

I. ARTERIA LACHRYMALIS.

THE LACHRYMAL ARTERY is the firſt branch of the ophthalmic; but, in order to know its place correctly, we muſt firſt obſerve how the ophthalmic artery enters the eye. It comes off from the carotid, where that artery touches the clynoid proceſs; and is ſo cloſe upon the proceſs, that the ſetting off of the ophthalmic is almoſt covered by that projection. It then dives under the optic nerve, and appears on the outer ſide of it; and as the artery goes along through the orbit, it makes a ſpiral turn till it completely ſurrounds the nerve.

The lachrymal artery goes off from the ophthalmic immediately after entering the orbit [*], though ſometimes it ariſes from the artery of the dura mater; and then it enters by the foramen lacerum, which is the next opening to the optic hole. It goes off from the ophthalmic about two or three lines after it has entered the ſocket. It goes all along the outer ſide of the orbit, becauſe the lachrymal gland lies in the outer corner of the eye. When it reaches the gland, it is branched out and entirely expended upon it, except that it ſends ſome ſmall twigs forwards to the eyelid.

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[*] Sometimes it goes off one or two lines before the ophthalmic enters the optic hole, ſometimes from the middle of the artery.

Of theſe vagrant branches, one twig goes to the perioſteum of the orbit, perforates the cheek bone, and ſo gets into the hollow of the temple, inoſculating with the deep temporal artery; while another little branch goes to the tarſus of the upper eyelid, and another to the tarſus of the lower eyelid, and thus ends the lachrymal artery.

SECOND ORDER.

In the ſecond order are included the arteries which go to the eye itſelf, viz. the ARTERIA CENTRALIS RETINÆ, and the CILIARY ARTERIES; of which arteries there is none more curious than the arteria centralis retinæ.

I. ARTERIA CENTRALIS RETINÆ.

This artery is ſo named becauſe it perforates the optic nerve, runs up through its very centre or axis, enters into the cavity of the eye through the very centre of the optic nerve, and ſpreads its branches all over the retina. It uſually ariſes from the ophthalmic artery, where it turns in the middle of the orbit over the upper part of the optic nerve *; it plunges into the nerve; and this artery, or rather the artery and vein, both (for the vein accompanies it) make ſo large a canal in the centre of the optic nerve,

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* It may be found ariſing from the ciliary arteries, or ſometimes from the muſcular.

that it ſtands quite open and gaping when the nerve is cut acroſs; and was long known to the older anatomiſts by the name of porus opticus, before the meaning of this orifice or hole was underſtood.

When this artery arrives within the eye, it branches out moſt beautifully upon the retina. The angles and meſhes which this artery makes give the name of retina or net-like to the whole; for the pulpy part of the optic nerve expands into a very thin and delicate web which reſembles mucus. This web has all its ſtrength from theſe branches of the central artery. The branches of the artery, and the mucus-like expanſion of the nerve, lie in two ſeparate layers; and hence ſome anatomiſts reckon the retina a double membrane.

The arteria centralis having given off ſidewiſe theſe innumerable branches to the retina, ſtill goes forwards, plunges through the ſubſtance of the vitreous humour, does not ſtop till it arrives at the back part of the lens, and is of courſe the ARTERIA CENTRALIS OCULI, the central artery of the eye itſelf. This central artery can no more be ſeen in the adult eye than the arteries of an unprepared bone; but by injecting the ſmall arteries of the eye of a fœtus, of a ſlink Calf, or of any young animal, the arteria centralis oculi is found to diſtribute its branches in the following way: As it goes forwards through the centre of the eye-ball, it gives off its delicate arteries from ſide to ſide, which go along the partitions of the vitreous humour (for the vitreous humour is divided everywhere by membranes into ſmall honeycomb-like cells). Theſe croſs arteries inoſculate with thoſe of the retina, and are plainly the arteries which ſecrete and ſupport the vitreous humour. The central artery ſtops when it comes to the back of the lens: it is ſcattered in a radiated form, as if by the reſiſtance, into a great many branches. Theſe branches go round all the capſule of the lens, and meet again on its fore part; where, uniting into one or more ſmall arteries, they paſs onwards into the opening of the pupil, and help to form that membrane which in the fœtus ſhuts out the light, protects the eye, and vaniſhes very gradually.

So the arteria centralis retinæ paſſes firſt through the centre of the optic nerve; next through the centre of the vitreous humour; next, after going round the capſule of the lens, it paſſes through the poſterior chamber of the aqueous humour, and terminates in the centre of the pupil. But as theſe laſt arteries, viz. of the pupil, vaniſh ſoon after birth, we may conſider the central artery as ending in inoſculations with thoſe arteries, which coming upwards along the ſides of the eye along with the retina, form a ſtrong circle of arteries at the root of the ciliary proceſs.

2. ARTERIÆ CILIARES.

The ciliary circle is known, upon looking outwardly at the eye, by that white line which borders the iris, and ſeparates the iris or coloured part of the eye from the white or colourleſs part. That circle marks the place where there is a great concourſe of arteries. The corpus ciliare, or ciliary body, is the part within the eye which lies flat upon the fore part of the vitreous and cayſtalline humours, which is like a ſecond iris behind the firſt, which is extremely vaſcular, and correſponds with the ciliary circle without. This corpus ciliare is radiated (that is a conſequence of the peculiar order and arrangement of its veſſels, which run in rays from the ciliary circle, *i. e.* from the circumference towards the centre). Theſe radii coming from the ciliary circle are called the ciliary proceſſes; ſo that the ciliary circle, corpus ciliare, and ciliary proceſſes, are all parts of the ſame vaſcular organ. This is the part of the eye to which all thoſe arteries go which are next to be deſcribed.

1. Two arteries of conſiderable ſize go off from the ſides of the ophthalmic artery: theſe go along the ſides of the optic nerve; they go towards the ball of the eye; and the one on the outer ſide of the eye is named EXTERNAL CILIARY ARTERY, that on the inner ſide of the optic nerve is named the INTERNAL CILIARY.

2. Theſe two divide themſelves again into two ſubordinate branches: one of them as ſoon as it touches the eye, that is, juſt beyond the implantation of the optic nerve, enters its ſubſtance, and is ſpread out on its choroid coat in a great number of branches, which are named CILIARES BREVES, the ſhort ciliary arteries: the other goes further forward upon the eye before it enters, and even after it enters it ſtill goes forwards to the very fore part of the eye before it divides; hence named CILIARES LONGÆ.

3. The ANTERIOR CILIARY ARTERIES are ſome ſmall and uncertain branches, which come ſometimes

from one ſource, ſometimes from another, but moſt commonly from the muſcular branches; and they go along with the muſcles, and conſequently enter the eye at its fore part juſt where the recti muſcles are inſerted. But, though ſmall, theſe anterior ciliary arteries are of conſiderable number.

From the places at which theſe ſeveral arteries enter the ball, one might gueſs a priori how they will be diſtributed through its coats.

Firſt, The ſhort ciliary arteries do not all of them ariſe from the ciliary trunk; but of this great number of very ſmall arteries, many ariſe from the muſcular branches. As ſoon as they touch the eyeball, they enter into it near the inſertion of the optic nerve, paſs through the ſclerotic coat (leaving for its nouriſhment a few twigs); they divide ſo, that juſt after they have entered, we can count twenty-five or thirty all round the root of the optic nerves, which go forwards in a radiated form, and are completely diffuſed upon the choroid coat, which they cover with an inner membrane, or rather tiſſue of veſſels, named tapetum, or tunica Ruyſehiana. This coat of veſſels lines the choroid all the way forward to the lens, goes ſtill onwards to the fore part of the lens; and then turning down upon the lens at right angles, it meets with the anterior veſſels, and forms the ciliary circle, and the ciliary proceſſes or radii, which are about thirty; ſo that the ſhort ciliary arteries having formed about thirty branches in entering at the back part, they now terminate by a like number at the fore part, of the eye. A few twigs go ſtill forward upon the uvea and iris, ſo as to make a very important connection of all the vaſcular parts of the eye.

Secondly, The LONGER CILIARY ARTERIES enter the ſclerotic a little further forward, penetrate at a greater diſtance from the optic nerve, they penetrate the ſclerotic a little before its middle; but ſtill they continue entire, or they give but very ſmall branches. When they approach the ciliary circle, they divide into two or three long arteries, which go off at right angles, embracing a correſponding quarter of the ciliary circle: from theſe arms their branches meet each other, and are now joined both by the ſhorter ciliary arteries and by the anterior ciliary arteries; by which conjunction an arterial circle is formed, which correſponds with the outer circle of the uvea, and is called the OUTER CILIARY CIRCLE: this again ſends radii of veſſels, perhaps thirty, inwards, which meeting form a ſecond circle, the INNER CILIARY CIRCLE.

Thirdly, The anterior ciliary arteries again enter the eye at its fore part, and immediately unite with theſe, as has juſt been explained; they help to form the ciliary circle, which is the great conjunction of all the internal veſſels of the eye.

THIRD ORDER.

IN this order are included the MUSCULAR ARTERIES, which are the leaſt regular of all the branches of the ophthalmic artery. From one or other branch of the ophthalmic there generally ariſe two muſcular arteries; the one for the upper, the other for the lower muſcles.

1. ARTERIA MUSCULARIS SUPERIOR.

THE UPPER MUSCULAR ARTERY conſiſts of ſmall twigs, which go chiefly to the levator palpebræ and rectus ſuperior; and theſe, though they ſometimes ariſe as two ſmall twigs from the ophthalmic artery itſelf, yet in general come off rather from that artery which, as it goes out by the ſupra-orbitary hole, is named the ſupra-orbitary artery. Theſe muſcular branches of the ſupra-orbitary, then, ſupply the upper muſcles of the eye, as the levator palpebræ, the obliquus major, the rectus ſuperior, and the ſclerotic or outer coat of the eye.

2. ARTERIA MUSCULARIS INFERIOR.

THE LOWER MUSCULAR ARTERY is very generally an independent artery, and pretty large. It comes off from that part of the ophthalmic artery where it is giving off the ciliary arteries. This muſcular branch is large enough to give off ſometimes the arteria centralis retinæ, and often ſome of the ſhort ciliary arteries ariſe from it; it is ſo long as even to reach the lower eyelid. The muſcles which it ſupplies are all thoſe which lie on the lower part of the eye, as the deprimens oculi, abducens oculi, obliquus minor. It alſo gives variable twigs to the ſclerotica, the optic nerve, the perioſteum of the orbit, and ſometimes to the adnata and lower eyelid.

FOURTH ORDER.

The ſet of arteries which ſtand next in order are thoſe which go down into the noſe through the æthmoidal bone, whence they are named æthmoidal arteries. The æthmoidal arteries are, like the other branches of the ophthalmic, pretty regular in their deſtination, but far from being regular in the manner in which they ariſe,

I. ARTERIA ÆTHMOIDALIS POSTERIOR.

The posterior æthmoidal artery is ſo named becauſe it paſſes through the poſterior of two holes which are in the orbit at the joining of the æthmoidal with the frontal bone[*]. It is an artery by no means regular in its place, coming ſometimes from the ophthalmic trunk, ſometimes from the lachrymal artery, very rarely from the ſupra-orbitary artery. It is of no note: it is the ſmaller of the two æthmoidal arteries; it goes through its hole, and is ſcattered upon the bones and membranes of the noſe. While it is circulating its twigs among the æthmoidal cells, it inoſculates, of courſe, with the naſal arteries of the external carotid.

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[*] In deſcribing the ſkull, theſe are named the internal orbitary holes.

2. ARTERIA ÆTHMOIDALIS ANTERIOR.

THE anterior æthmoidal artery is rather more regular and more important; it paſſes through a larger hole, and is itſelf larger; it comes off more regularly from the ophthalmic trunk, and it goes not down into the noſe, but upwards into the ſkull.

The ophthalmic artery, much exhauſted by giving off many branches, has riſen over the optic nerve, has completed its ſpiral turn, and has juſt got to the inner corner of the eye, where the æthmoid hole is, when the anterior æthmoid artery ariſes from it. It ariſes juſt behind the pulley of the upper oblique muſcle, plunges immediately into its peculiar hole, and, paſſing along a canal within the æthmoid bone, it merely gives twigs to the frontal and æthmoidal ſinuſes, and paſſes up by one of the largeſt holes in the cribriform plate of the æthmoid bone. When within the ſkull, it is under the dura mater, betwixt it and the bone; it goes to the dura mater and to the root of the falx, and ſome of its delicate twigs turn downwards again into the noſe, through the ſmall holes of the cribriform plate accompanying the branches of the olfactory nerve.

FIFTH ORDER.

THE fifth order of arteries is very numerous, including all thoſe which ſend their twigs outwards upon the face. They are the ſupra-orbitary artery, the artery of the upper eyelid, the artery of the lower eyelid, the artery of the forehead, and the artery of the noſe.

1. ARTERIA SUPRA-ORBITALIS.

THE ſupra-orbitary artery is ſo named from its emerging from the ſocket by that notch in the ſuperciliary ridge which we call the ſupra-orbitary hole. It comes off from the ophthalmic artery at the place where it gives off the ciliary and lower muſcular arteries: it ſo often gives off the arteries which go to the upper muſcles of the eye, that ſome have named it the ſuperior muſcular artery. It paſſes onwards, giving twigs to the levators of the eye and of the eyelid, and to the upper oblique muſcles, and to the perioſteum; and before it arrives at the ſupra-orbitary hole, it divides into two twigs; of which one lies deep, and ſupplies the perioſteum of the forehead, inoſculating with the temporal artery; the other lies more ſuperficial, but ſtill is covered by the orbicularis and corrugator ſupercilii, on which muſcles it beſtows all its branches.

2. ARTERIÆ PALPEBRALES.

THE two PALPEBRAL ARTERIES ariſe from the ophthalmic after it has paſſed the tendon of the obliquus ſuperior, when it has in a manner emerged from the ſocket, and is lying at the inner angle of the eye: there it commonly gives off two ſmall arteries, one to the upper and one to the lower eyelid; and often the two ariſe by one trunk.

ARTERIA PALPEBRALIS INFERIOR.—The ARTERY of the LOWER EYELID is the branch of the two which goes off the firſt; but it is the ſmaller and leſs regular of the two. Its twigs go one to the union of the two tarſal cartilages, to the caruncula lachrymalis, and to the adjoining part of the adnata; another goes deeper, viz. to the lachrymal ſac, and even into the æthmoid cells; and a third twig runs along the margin of the tarſus, named tarſal artery, ſupplying the Maibomian glands.

ARTERIA PALPEBRALIS SUPERIOR.—The ARTERY of the UPPER EYELID ariſes along with the lower palpebral or near it; it gives few branches; one keeps to the angle of the eye, and ſupplies the orbicularis oculi, the caruncula, and the tunica conjunctiva; another having pierced the fibres of the oblique muſcle, runs along the borders of the tarſus, inoſculating with a ſimilar branch of the lachrymal artery, and forming an arch along the upper tarſus as the other does below.

3. ARTERIA NASALIS.

THE NASAL ARTERY goes off at the edge of the orbit, riſes over the lachrymal ſac, and over the ligament of the eyelids; it firſt gives a twig upwards to the root of the frontal muſcle; then another goes down over the lachrymal ſac, and after giving branches to the ſac, goes to the orbicularis muſcle, and inoſculates with the infra-orbitary artery; and laſtly, the moſt remarkable branch of this artery, from which indeed it has its name, runs down upon the ſide of the noſe, making a beautiful net-work, and inoſculating with the laſt branch of the labial artery which runs up to meet it *. This is quite a cutaneous artery; many of its twigs go to the ſkin; it is felt beating ſtrongly; it was often opened when arteriotomy was more regarded than it is now.

4. ARTERIA FRONTALIS.

THE FRONTAL ARTERY is now to be diſtinguiſhed from the ſupra-orbital; for the ſupra-orbital riſes deep in the ſocket, emerges by the ſupra-orbitary hole, paſſes along chiefly betwixt the bone and muſcles, and makes no remarkable figure upon the face; while this, the frontal artery, is larger, keeps chiefly upon the ſurface of the muſcles, is quite ſubcutaneous, has nothing to do with the ſupra-orbitary hole, and riſes beautifully upon the forehead. It is a delicate and ſlender artery, not ſo large as the naſal, and looks like one of its branches; it gives off firſt a branch to the eyelids, named ſuperciliary artery, which ſupplies the root of the frontal and the upper part of the orbicularis muſcles; it ſends an aſcending branch which dives under the frontal muſcle, and belongs chiefly to the os frontis and pericranium. This is

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* Some of its branches abſolutely penetrate the cartilages of the noſe, and ſo get acceſs to the Schneiderian membrane, and ſupply it with blood.

the little artery which often makes a perpendicular groove in the os frontis. The chief branch of the artery continues ſubcutaneous, is felt beating along the forehead, belongs chiefly to the ſkin of the forehead and to the hairy ſcalp, and mounts to the top of the head, to the place of the fontanelle, where it has free inoſculations with the temporal artery.

This laſt branch is the end of the ocular or ophthalmic artery, of which the branches are ſo irregular in their origin, that the moſt diligent anatomiſts have declined that part of the deſcription, and yet have arranged the branches upon that ſcheme, viz. the points from which the ſeveral twigs ariſe: whereas I have thought it more prudent, ſince the branches are regular in reſpect of the parts which they ſupply, to arrange them according to thoſe parts, viz. the lachrymal gland, the eyeball, the muſcles, the æthmoid cells, the face; an order which alſo very nearly correſponds with the order in which the arteries ariſe. The learning and remembering theſe arteries, it is right to acknowledge, is a taſk more difficult than uſeful; more ſuiting the ſevere anatomiſt, than the practical ſurgeon; who yet, if he do his duty, will learn all; and as he learns much, muſt expect to forget much.

CONCLUSION.

Before I leave this difficult ſubject, I ſtop one moment to explain a point which might leave ſome confuſion in the reader's mind; and regarding chiefly thoſe little arteries which belong to the membranes of the brain.

It is of great importance in ſtudying the brain, to know the manner in which its membranes are connected with it; and it is eſpecially to be remarked, that the internal ſurfaces, or, in other words, the cavities of the brain, need to be ſupported, nouriſhed, and ſupplied with blood as much as the external ſurface; and that for this end the pia mater turns inwards and lines all the cavities of the brain.

At different points the pia mater and its arteries take various forms, and are called RETE MIRABILE, VELUM, or CHOROID PLEXUS, according to that form.

The RETE MIRABILE has already been explained, as being that diviſion and reunion of the branches of the carotid artery by which the force of the aſcending blood is broken before it enters the brain. In many of the lower animals this proviſion of Nature is moſt curious and particular; but in Man it would appear, that the erect poſture in which he walks, the contortions of the carotid artery as it enters the ſkull, the manner in which it lies in the cavernous ſinus, and, finally, the minute diviſion which it undergoes by ſpreading over the pia mater before it enters the brain, are ſufficient. In Man there is not the ſmalleſt veſtige of a rete mirabile; and whenever we find a rete mirabile deſcribed in Man (as often it has been deſcribed), we find invariably that it means no more than the plexus of delicate veſſels which go out from the firſt twigs of the carotid artery, either to ſupply

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the membranes or to enter into the cavities of the brain; and accordingly we find theſe authors calling it "a beautiful beginning of a rete mirabile;" "an imperfect rete mirabile," &c.

The VELUM, as it is called, is that netted form which the pia mater aſſumes often about the baſis of the brain, whenever the ſmaller arteries are numerous; for the inoſculations of the arteries are like a net-work; the arteries, full of blood or of injection, are opaque and are very apparent; while the membrane upon which they run is lucid, diaphanous, and is ſcarcely ſeen. A velum or net of this kind appears on every ſmooth and uniform ſurface of the baſis of the brain; but the moſt remarkable of all is that which lies betwixt the brain and the cerebellum. It is named velum interpoſitum; and at this place inſinuates itſelf (betwixt the brain and the cerebellum) into the back part of the lateral ventricles, where it covers the nates, teſtes, and pineal gland.

The PLEXUS CHOROIDES again is merely another variety or form of the pia mater. The great choroid plexus is a membrane which lies upon the bottom of each lateral ventricle: it is netted and extremely vaſcular, not unlike the chorion of ſome animals, whence it is named. It conſiſts partly of arteries, but chiefly of veins; it conveys ſome blood to the internal ſurfaces of the brain, but returns much more.

But although the choroid plexus of the two lateral ventricles be the chief one, the third and the fourth ventricles have each their plexuſes or vaſcular webs. The chief points by which theſe vaſcular webs of the pia mater enter are by the anterior and poſterior horns of the lateral ventricles; at which points, and indeed at all the lower parts of the brain, the ventricles muſt be conſidered as ſhut, ſince theſe vaſcular linings, as they enter, adhere on all ſides: but may alſo be conſidered as open, ſince they admit theſe membranes, ſince they are ſhut only by their ſlight adheſion, and may be opened by pulling the parts gently aſunder.

This, then, is a general explanation of that vaſcular part of the pia mater which covers all the baſis, and lines all the cavities, of the brain. It is one continuous membrane, under the various titles of rete mirabile, which ſome older anatomiſts uſe; of velum, a name chiefly repeated by Haller; and of plexus choroides, a name univerſally uſed for that net-work of veſſels which lies out upon the floors of the ventricles. It will be ſeen hereafter how greatly a knowledge of theſe inflections contributes to the right underſtanding of the brain and its parts and cavities.

CHAP. II.

OF THE ARTERIES OF THE ARM.

The ſubclavian arteries ariſe from the arch of the aorta. The left ſubclavian ariſes from the extremity of the arch, and juſt where the aorta is turning down towards the ſpine. It is longer within the thorax, runs more obliquely to paſs out of the cheſt, receives in a leſs favourable direction the current of the blood. But the right ſubclavian ariſes from the aorta by that artery which is called the ARTERIA INNOMINATA; for it is an artery which can have no name, being neither the carotid nor the ſubclavian, but a trunk common to both. It is large, riſes from the top of the aortic arch, receives the blood in the moſt direct manner; from which phyſiologiſts have deduced thoſe conſequences which have been already explained *.

The artery of the arm, as it proceeds, changes its name according to the parts through which it paſſes. It is named ſubclavian within the breaſt, axillary in the arm-pit, brachial as it goes down the arm, and

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* Douglas ſays the left is ſhorter, which I can by no means underſtand.

when it divides at the bending of the arm its two branches are named the radial and ulnar arteries, after the radius and ulna, along which they run, until at laſt they join to form vaſcular arches in the palm of the hand.

Nature has thus arranged and divided the parts of this artery; and the ſtudy of its branches becomes eaſy to thoſe who will firſt condeſcend to obſerve this ſimple arrangement and the parts through which it goes. 1ſt, While the artery is within the breaſt, it lies tranſverſely acroſs the root of the neck; it ſupplies the neck, the breaſt, the ſhoulder; it gives all its branches upwards into the neck, or downwards into the breaſt: upwards it gives the vertebral to the inſide of the neck (if I may uſe an expreſſion which cannot now be miſunderſtood); the cervical, which goes to the outſide of the muſcles of the neck; the thyroid, which goes to the thyroid gland. While it gives off from its oppoſite ſide downwards, and into the cheſt, the mammary, which goes to the inner ſurface of the breaſt; the upper intercoſtal artery which ſerves the ſpace betwixt the uppermoſt ribs; the mediaſtinum and pericardium; and even the diaphragm, through far diſtant, receives branches from this mammary artery.

2. When the artery, having turned over the ſloping part of the cheſt, glides into the axilla, and lies deep there betwixt the ſcapula and the thorax, what parts can it ſupply, or what veſſels can it give off, but ſcapular and thoracic arteries? Its branches accordingly are three or four ſlender arteries to the thorax on one hand, named the four thoracic arteries, which give

twigs to the glands, the pectoral muſcles, and the breaſt or mamma; and on the other hand it gives off firſt great articular arteries which ſurround the joint, and ſtill great ſcapular arteries which ſurround the ſcapula, and nouriſh all that great maſs of fleſh which lies upon it.

3. But when this artery takes the name of the humeral artery, and paſſes along the arm, it muſt be ſimple, as the arm is ſimple; for it conſiſts of a bone of one maſs of muſcles before and another behind: the artery of courſe runs along the bone undivided, except that it gives off one branch, which runs parallel along with the main artery, and which running deeper among the fleſh, is named muſcularis or profunda.

4. It divides at the bend of the arm, in order to paſs into the forearm in three great branches. In wounds thus low, all danger of looſing the arm from wounds of the artery, unleſs by the groſs ignorance or fault of the ſurgeon, is over: we do not attend ſo much to the parts which it ſupplies, or, in other words, to its inoſculations, as to the parts againſt which the great branches lie. We obſerve here, as on all occaſions, the artery ſeeking protection, and running upon the firmeſt parts: its three branches now paſs; one along the radius, another along the ulna, a third along the interoſſeous membrane.

5. In the palm of the hand we find the artery ſtill following the order of the bones; and as the carpal bones are as a centre or nucleus, upon which the metacarpal and finger-bones ſtand like radii, the palmar artery forms a complete arch, from which all

the fingers are ſupplied by arteries, iſſuing in a radiated form.

Of all theſe ſubdiviſions the ſubclavian artery is that which ſeems the leaſt important to know; and yet without a perfect knowledge of it, how ſhall we underſtand many important arteries of the neck or ſhoulder? How ſhall we underſtand the anatomy of the greateſt of all the nerves, viz. the ſympathetic nerve which twiſts round it? How ſhall we judge rightly of tumours near it, or of aneuriſms which ſo often mount along this artery from the arch of the aorta until they are felt here?——Of the ſecond diviſion of the artery, viz. where it lies in the axilla, the importance is moſt unequivocal; ſince every attempt to ſtop hæmorrhagies, by compreſſing this artery, requires a knowledge of it; ſince every full bleeding wound near this place alarms us, and requires all our knowledge; ſince every tumour that is to be extirpated opens ſome of its branches; ſince we cannot cut off a cancerous breaſt, or the glands which ſhould be taken along with it, without cutting the thoracic arteries.— Next the artery of the arm, ſimple as it is, intereſts us greatly. It is this ſimple artery which is hurt in aneuriſms; it is its delicate, I had almoſt ſaid capillary, branches, which are to eſtabliſh a new circulation, and to ſave the limb. We have indeed no apprehenſions of loſing the limb for want of blood (the continual ſucceſs of our operations having eſtabliſhed this point); yet it is moſt intereſting to obſerve the extreme ſmallneſs of theſe branches, as an aſſurance to us in other caſes of danger; though I do indeed believe, that there cannot in any ſimple wound in any limb be the ſmalleſt danger from this much dreaded obſtruction of the blood.

The arteries of the forearm are more intereſting ſtill; for if we will be ſo ſelfiſh as to conſider the difficulties of the ſurgeon merely, wounds of the arteries in the forearm are very diſtreſſing. Theſe arteries lie deep among the muſcles, drive their blood (when wounded) through the whole arm, and either occaſion a difficult and moſt painful diſſection, or cauſe a deep and gangrenous ſuppuration; ſo that whether the ſurgeon be ſo dexterous as to ſecure the arteries, or ſo timid as to leave the arm in this woeful condition, the patient is to undergo ſuch ſufferings by pain, or by a long diſeaſe, as muſt intereſt us greatly.

The arteries even of the wriſt and hand, though ſmall, are important. The difficulty of managing wounds of theſe arteries ſtands but too often recorded in all kinds of books for us to doubt the fact. If many have died after frequent bleedings from theſe arteries, though under ſkilful hands, what ought we not to ſubmit to in the way of ſtudy and labour to acquire and to retain a knowledge of theſe arteries; ſince by that alone every thing that is ſurgical in tumours, aneuriſms, amputations, is well or ill performed according to our degree of knowledge; and ſince, according to our degree of knowledge, we are diſengaged in our minds, and have free poſſeſſion of our judgment, to do any thing which may be required? In ſhort, as we proceed along this artery, we ſhall perceive that each diviſion of it riſes in importance; or at leaſt, that if wounds about the axilla be more dangerous, they are proportionably rare; that if accidents about the wriſt or hand be leſs dangerous, they are, however, more frequent, ſo as to deſerve every degree of attention.

I. OF THE SUBCLAVIAN ARTERY.

THIS artery is ſo named from its paſſing under the clavicle by which it is protected; and we include under this diviſion all that part of the artery which lies betwixt the arch of the aorta and the outſide of the clavicle, where the artery comes out upon the cheſt. Here the artery is of a very great ſize; it lies directly acroſs at the top of the cheſt and root of the neck; and like a cylinder or axis, it gives its branches directly upwards and directly downwards to the throat, to the neck, and the parts within the cheſt. Upwards it ſends the vertebral, the thyroid, the cervical, and all the humeral arteries; downwards it ſends the upper intercoſtal artery, and alſo the internal mammary, which, beſides its going along the inner ſurface of the cheſt, gives branches to the pericardium, mediaſtinum, thymus, and other parts.

1. ARTERIA MAMMARIA INTERNA.

THE INTERNAL MAMMARY ARTERY is the firſt which the ſubclavian gives off; it is of the ſize of a crow-quill, long, ſlender, its ramifications very beautiful. On each ſide of the cheſt the mammary artery paſſes down along all the inner ſurface of the ſternum, and ends at the cartilago enſiformis in numerous inoſculations with the epigaſtric artery; for the epigaſtric ariſes from the femoral at the groin, juſt as this does from the ſubclavian at the top of the cheſt, and runs upwards along the belly, as this the mammary runs downwards along the breaſt till they meet each other midway. This is an inoſculation, which fifty years ago was much noticed. Phyſiologiſts deduced the moſt important conſequences from it, aſcribing the connection of the breaſt and womb to the flux and reflux, to the alternate ſtoppage and acceleration of the blood in theſe veſſels; although the ſympathy of the breaſts and womb is plainly a connection which Nature has eſtabliſhed upon other laws, upon a kind of ſympathy ſuch as we ſee everywhere in the ſyſtem, but can in no inſtance explain.

The courſe of the mammary artery, and the order of its branches, is this: It goes off from the lower and fore part of the axillary artery; it lies on the outſide of the membranous bag of the pleura; and conſidering the pleura as ending in an obtuſe and riſing apex, the mammary artery lies at firſt a little behind the pleura, its firſt movement is to riſe and turn with an arch over the top of the pleura or bag which incloſes the cavity of the cheſt; there it deſcends again, and paſſes betwixt the ribs and pleura; the artery runs along the inſide of the thorax under the middle of the cartilages. At the ſeventh or eighth rib the mammary itſelf emerges from the thorax, and becomes an external artery; it firſt ſends a branch towards the enſiform cartilage, which plays round it, and then it goes to the upper part of the abdominal muſcles by two diſtinct branches, the one of which is internal, the other external. The internal branch goes into the belly or ſubſtance of the rectus muſcle, deſcends nearly as far as the navel, and inoſculates with the epigaſtric artery. The external branch turns off to one ſide, goes rather to the lateral muſcles of the abdomen, eſpecially to the two oblique muſcles, and it inoſculates more with the lumbar arteries; and ſo the mammary ends. But as it paſſes down along the cheſt, it gives the following branches:

Firſt, Where it is paſſing the clavicle, bending to go downwards, it gives a ſmall retrograde branch which follows the courſe of the clavicle, and goes to the muſcles and ſkin of the neck [*].

Secondly, It gives an artery, or rather arteries, to the thymus ARTERIÆ THYMICÆ. Theſe are in the adult extremely ſmall, becauſe the gland itſelf is ſo; but in the child the gland is large, the upper part lies before the trachea, the lower part lies upon the heart, or rather upon the pericardium betwixt the two lobes of the lungs: the upper end then is ſupplied by the thyroid arteries; the middle part is often ſupplied by a diſtinct and particular branch, viz. by this ARTERIA THYMICA coming from the mammary, but this is far from being always ſo; the loweſt part of the gland has twigs from thoſe arteries which properly belong to the mediaſtinum, upon which it lies, or to the pericardium, or to the diaphragm.

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[*] Sabbatier is ſo confuſed, and copies Haller ſo ill, that he miſtakes this for the tranſverſalis humeri, which is really an important artery.

Thirdly, The mammary gives alſo the upper artery of the diaphragm, its lower artery being the firſt branch of the aorta within the abdomen. This upper artery of the diaphragm is named ARTERIA COMES NERVI PHRENCI, becauſe it accompanies the phrenic nerve. The phrenic nerve is paſſing from the neck (where it ariſes) into the cheſt, by the ſide of the axillary artery, when it receives from the mammary this ſmall artery which goes along with it; and this artery (which is ſo extremely ſmall that nothing but its regularity can give it any importance) goes down through the whole cheſt, accompanying the phrenic nerve over the pericardium till they arrive together on the upper ſurface of the diaphragm, and ſpread out there. This artery, ſmall as it is, gives twigs as it paſſes along to almoſt all the parts within the cheſt.

Fourthly, The mammary gives an artery to the pericardium, which may be called the UPPER PERICARDIAC ARTERY; and which is of ſuch importance, that generally when it does not come off from the mammary, it comes from the ſubclavian itſelf, or even from the aorta. It belongs to the upper and back part of the pericardium.

Fifthly, The pericardium has another artery from the mammary, which belongs to that part of the heart which is united to the diaphragm: it is thence named by ſome ARTERIA PHRENICO-PERICARDIACA.

Sixthly, The mammary gives many ſmall arteries to the mediaſtinum; for the mammary is covered only by the ſterno-coſtalis muſcle, which is often hardly viſible in Man, ſo that the artery may be ſaid to lie upon the pleura, betwixt it and the ribs. The mediaſtinum is juſt that doubling of the pleura which deſcends from the ſternum to the ſpine, and of courſe many ſmall arteries go down from the lower ſurface of the ſternum along the pleura into the mediaſtinum, and by that to the pericardium, or even to the membrane of the lungs; for the pericardium is one inflection of the pleura and mediaſtinum, and the covering membrane of the lungs is another.

The mammary, as it goes downwards, ſends branches through the interſtices of the ribs; two twigs paſs through each interſtice, going to the intercoſtal muſcles, and to the muſcles which lie upon the thorax, as the pectoral muſcles; alſo to the mamma, to the obliquus externus abdominis, and to form loops of inoſculations round the ribs with the proper intercoſtal and thoracic arteries. Theſe twigs paſs through the interſtices of the ſix or ſeven upper ribs, but at the ſeventh the artery itſelf comes out. They are too numerous and too ſmall to be either counted or named.

Seventh, The mammary, before it terminates in the two branches, of which one keeps the middle and goes to the rectus muſcle, while the other goes outwards to the oblique muſcle, as already deſcribed, gives about the place of the ſixth rib a branch which, in place of paſſing out of the thorax, keeps to its inner ſurface, goes downwards along the ſeventh, eighth, and ninth ribs, makes its inoſculations there with the intercoſtal and other arteries, and ends in the ſide of the diaphragm, and in the tranſverſe or innermoſt muſcle of the abdomen, which indigitates, as we call it, with the diaphragm. From this deſtination it is ſometimes named the RAMUS MUSCULO-PHRENICUS.

2. ARTERIA THYROIDEA INFERIOR.

THE LOWER THYROID ARTERY, whoſe branches go to the neck, the ſhoulder, and the thyroid gland, ariſes from the fore part of the ſubclavian artery, cloſe upon the origin of the internal mammary. It is there covered by the root of the maſtoid muſcle. It buds out from the root of the great axillary artery, in the form of a ſhort thick ſtump, which immediately divides whip-like into four ſmall and ſlender arteries.

1. The main branch of this artery is again named the ramus thyroideus arteriæ thyroideæ. This thyroid artery is the firſt great branch; it does not aſcend directly, but moves a little inwards towards the trachea, from which the root is a good deal removed; it bends behind the carotid artery, is tortuous, aſcends by the ſide of the trachea till it touches the lower lobe of the thyroid gland; it ſpreads upon it like a hand, inoſculates very freely with the upper thyroid artery, and nouriſhes the gland. This branch moreover gives ſome twigs upwards to the lower conſtrictors of the pharynx and to the œſophagus; but its chief arteries, beſide thoſe which plunge into the gland, are its TRACHEAL ARTERIES. Theſe tracheal arteries, two or three in number, are reflected along the trachea, turn down with it into the cheſt, and reach even to the bifurcation of the trachea, where, inoſculating with the intercoſtal arteries, they form a moſt beautiful net-work.

2. The

The aſcending thyroid artery, or thyroidea
lens, is a ſmall and delicate branch, which lies
deep, going off rather from the back part of
tery; it ſupplies all the deep parts of the neck,
ven penetrates the vertebræ; it ſoon divides into
regular number of branches; the artery keeps
cloſe to the naked vertebræ, lying under moſt
muſcles; its general tendency is upwards,
nding the neck in a ſpiral form. Its chief twigs
irſt, ſome which go towards the ſurface, *i. e.* to
uſcles which lie over the artery, as to the
us, the maſtoid muſcle, the levator ſcapulæ, and
lenius; and twigs of this artery play over the
capitis and the anterior ſurface of the vertebræ,
tach themſelves to the eighth pair of nerves, and
ganglion of the ſympathetic nerve. Its deeper
s again go to the intertranſverſarii and other
s which lie cloſer upon the neck; and theſe are
anches which paſs in through the intervertebral
and penetrating the ſheath of the ſpinal mar-
and following its nerves, inoſculate with the
arteries.

The tranſverſe artery of the neck, or tranſ-
s colli, is an artery of the ſame kind with
ſt, viz. chiefly deſtined for the muſcles, but more
icial. It paſſes obliquely round the neck out-
and upwards, goes under the trapezius muſcle,
vered by it ſends branches as far as the occiput.
igs are diſtributed thus: Firſt to the maſtoid
and to the ſkin; next to the trapezius, levator
e, and ſplenius; then a long branch paſſing
ely upwards over the ſplenius, and under cover
of

of the trapezius, gives twigs to thoſe muſcles, and ends in inoſculations with the lower branches of the occipital artery; and laſtly, another branch goes downwards towards the ſcapula and ſhoulder.

4. The laſt branch of this artery is the TRANSVERSALIS HUMERI; an artery ſo important in its deſtination, and ſo irregular in its origin, and ſo frequently ariſing as a diſtinct and particular branch, and having ſo little relation to theſe trivial branches of the thyroid artery, that I ſhall deſcribe it by itſelf.

3. ARTERIA VERTEBRALIS.

THE vertebral artery ariſes next from the upper part of the ſubclavian artery; and running upwards and backwards but a little way, it plunges into the hole deſtined for it in the vertebræ; and it has been already deſcribed through all its courſe both within the bony canal and within the brain.

4. ARTERIA CLAVICALIS PROFUNDA.

THE deep cervical artery comes next in order; it is generally the leaſt important of all the branches from the ſubclavian artery, and the leaſt regular in its place. It often comes from ſome other branch, and often it is entirely wanting; its courſe reſembles a good deal that of the tranſverſalis colli, *i. e.* it goes to the deepeſt muſcles of the neck, and to the vertebræ, and ends about the occiput; it uſually ariſes from that part of the ſubclavian artery where it is juſt going to paſs, or has already paſſed, betwixt the ſcaleni muſcles. Its branches are few in number, it gives branches to all the ſcaleni muſcles; others alſo which play over the anterior ſurface of the vertebræ and the deep muſcles of the neck, as the ſpinalis colli; intertranſverſarii, the root of the ſplenius and trachelo maſtoideus; the complexus alſo receives a branch, which uſually inoſculates with the occipital artery.

5. ARTERIA CERVICALIS SUPERFICIALIS.

THE SUPERFICIAL CERVICAL ARTERY is ſtill leſs regular, being very often ſupplied by the thyroid. Its courſe is directly the reverſe of the laſt, running rather outwards and downwards, or, in other words, belonging rather to the ſhoulder than to the neck. The ſubclavian artery has got from under the muſcles, and has paſſed the ſplenii a little way before it gives off this ſuperficial cervical. This artery immediately attaches itſelf to the plexus of the brachial nerve, and is indeed hidden in the plexus: its firſt branch is given to the plexus, but its next and chief branch goes acroſs to the top of the ſhoulder; it ſends branches to the levator ſcapulæ, trapezius, and even to the ſkin; while a deeper branch goes to the ſplenius and complexus, where theſe muſcles ariſe in the neck; and when this artery is large, it ſends branches along the margin of the ſcapula, which go even to the ſerratus major, rhomboides, latiſſimus dorſi, &c.

AFTER enumerating theſe jarring names, I perceive the neceſſity of arranging once more thoſe arteries which go to the neck. Let the ſtudent then obſerve, 1. That the vertebral artery goes to the brain, that the cervical arteries belong to the muſcles of the neck. 2. That the thyroid gives two arteries to the neck, the thyroidea aſcendens and the tranſverſalis colli. 3. That when a ſecond ſet of arteries for the neck begins to be enumerated, the name is changed; that of colli is dropped, and that of cervicis adopted. 4. That as there are two branches of the thyroid going to the neck, viz. the aſcending thyroid and the tranſverſalis colli, there are alſo two entire arteries going to the neck, and which come off immediately after the thyroid, viz. the cervicalis profunda more conſtant, and the cervicalis ſuperficialis which is leſs regular.

6. ARTERIA INTERCOSTALIS SUPERIOR.

The upper intercostal is given to ſupply the intercoſtal ſpace betwixt the two uppermoſt ribs, becauſe the aorta which gives out all the other intercoſtals, regularly one for each rib, does not begin to give them off till after it has made its turn downwards; of courſe it leaves the two upper ribs without arteries. To ſupply this, then, is the office of the ſuperior intercoſtal artery, which is about the ſize of a crow-quill, and goes off from the ſubclavian generally next after the vertebral and thyroid arteries. It comes from the upper and back ſurface of the ſubclavian trunk; it turns downwards and backwards, and lodges itſelf by the ſide of the ſpine in the hollow where the ſpine and the firſt rib are joined, and where the firſt thoracic ganglion of the great intercoſtal nerve lies. Before it takes its place betwixt the ribs, as the intercoſtal of the two upper ſpaces, it ſends a branch upwards upon the face of the lower vertebræ of the neck, which is given to the ſcaleni, to the longus colli muſcle, and to the nerves: next it gives off the higheſt intercoſtal artery for the ſpace betwixt the firſt and ſecond ribs, which artery divides into two branches; one perforates the thorax, and goes out upon the back, and ſupplies the muſcles which lie flat upon the back of the cheſt; while another branch, the proper intercoſtal branch, runs along betwixt the ribs.

Next it gives off a ſecond intercoſtal artery, which alſo has its external and internal branches, and of which a branch inoſculates over the third rib with the uppermoſt intercoſtal of the aorta. Beſides theſe, it gives alſo ſmall branches to the œſophagus, which inoſculate with the tracheal arteries; and it gives branches to the ſpinal marrow, which paſs into the canal along the holes for the nerves; and which not only ſupply the ſheath, but alſo inoſculate with the arteries of the ſpinal marrow itſelf.

7. ARTERIA SUPRA-SCAPULARIS.

THE SUPRASCAPLUAR ARTERY, or the ſuperior ſcapular artery, is one of ſuch magnitude, is ſo different in ſize and deſtination from the cervical and other ſmall arteries of the neck, that it ought to be deſcribed apart; though of great ſize and importance, it is yet ſo little known, that Sabbatier does not even deſcribe nor name it.

The SUPRASCAPULAR ARTERY very often comes off from the THYROID artery; in which caſe it is the laſt in order of all the branches of the thyroid, that is to ſay, the neareſt to the ſhoulder, and then it is named TRANSVERSALIS HUMERI, becauſe of its going acroſs the root of the neck to the ſhoulder. Sometimes it ariſes from the cervicalis ſuperficialis; but then it is a ſmall artery, and I ſuſpect it reaches in ſuch caſes no further than the tip of the ſhoulder, and does not deſcend to the ſcapula. Often I ſee it ariſing as a diſtinct artery, large, very long, tortuous like the ſplenic artery, and almoſt equalling it in ſize; running acroſs the root of the neck, till at the top of the ſhoulder it dives under the acromion proceſs; and then paſſing through the notch of the ſcapula, ſupplies all the fleſh of its upper ſurface.

The reaſon of my naming it ſupraſcapular artery, is its paſſing thus over the ſcapula, while another, the largeſt branch of all thoſe proceeding from the ſubclavian artery, is named ſubſcapularis, from paſſing under the ſcapula.

To repeat the origin then of this ſupraſcapular artery, it ariſes ſometimes as an independant artery, and is ſo great, that we wonder that it does not always do ſo: often it ariſes from the thyroid, is its laſt branch, and is named TRANSVERSALIS HUMERI, authors not obſerving that it belongs abſolutely to the ſcapula; it rarely ariſes from the cervicalis ſuperficialis; and when it does ſo, it is ſmall: often in a ſtrong man it ariſes apart; and when it does ariſe from the thyroid or cervical arteries, it is ſo large as to annihilate as it were all the other branches of the artery from which it ariſes.

Where this artery paſſes out of the cheſt it is covered only by the root of the maſtoid muſcle; and it gives twigs to the maſtoid, to the muſcles which aſcend to the throat, to the ſubclavian muſcle, to the fat, jugular vein, and ſkin.

Next it gives a ſuperficial branch to the ſkin, trapezius, and other ſuperficial parts about the ſhoulder.

Next it turns over the acromion proceſs, paſſes through the ſupraſcapular notch, with many windings and contortions; ſpreads itſelf over all the outer ſurface of the ſcapula, both above and below the ſpine, and is the ſole ſupraſcapular artery. The manner of its ſpreading is this; having paſſed through its hole in company with the ſupraſcapular nerve, the inſtant that it has paſſed the hole and begins to lie flat upon the ſcapula, it ſends off two branches, one on either hand at right angles; and of theſe one goes along the upper border of the ſcapula towards its baſis, the other goes in the other direction towards the ſhoulder-joint, and circles round the upper ſide of the ſpine or ridge of the ſcapula.

The main artery having firſt perforated the ſcapular notch, and given theſe two ſmall branches, next makes a ſecond perforation, viz. by paſſing under the root of the acromion proceſs; and then it again divides into large branches, in which it ends. The one branch runs all along the root or baſe of the ſpine or high ridge; the other branch runs nearly in the ſame direction, but lower down, viz. nearer that edge

where

where the great ſubſcapular artery runs; and with which, of courſe, it makes many free inoſculations.

This artery lies ſo acroſs the neck that it may be cut, eſpecially in wounds with the ſabre; and in a big man it is of ſuch ſize as to pour out a great quantity of blood. It is neceſſary for the ſurgeon to remember the great ſize of this ſupraſcapular artery, its long courſe over the ſhoulder, at what place it ariſes within the cheſt, and how it may be compreſſed. But in another ſenſe alſo it is peculiarly important; for the ſupraſcapular artery makes inoſculation with the lower ſcapular artery, freer, and fuller, than in almoſt any other part of any limb. One can hardly force tepid water through thoſe ſmall arteries which ſupport the arm after the operation for aneuriſm; but the inoſculations of this ſupraſcapular artery are ſo free, that often, though I have tied the arteries with great care, the very coarſeſt injection has gone round by it; and when I deſired only to inject the head, I have found the arteries of the arm entirely filled. The concluſion which this leads to in wounds of the axillary artery is too obvious to need any further explanation.

II. OF THE AXILLARY ARTERY.

This artery aſſumes the name of axillary, where it lies in the armpit or axilla. The ſcaleni muſcles being attached to the ribs, the artery paſſes firſt through betwixt the firſt and ſecond ſcalenus; next it paſſes out from under the arch of the clavicle, where it was protected; then it falls over the breaſt in a very oblique direction; it inclines outwards towards the axilla, lies flat upon the ſlanting convexity of the cheſt, is covered by the pectoral muſcles, becauſe the pectoral muſcles ariſe from the clavicle, under which the artery paſſes; but far from being protected, it is ſo far expoſed as to be eaſily felt beating, and it is at this point only that it can be rightly compreſſed. It declines ſtill outwards and downwards, till at laſt it gets ſo deep into the arm-pit, and ſo much under the ſcapula, as to lie betwixt the ſerratus anticus and ſubſcapular muſcles. There it is rightly called the axillary artery. In this hollow it lies ſafe, protected by the deep borders of the pectoral muſcle before, and of the latiſſimus dorſi behind, ſurrounded with fat and glands, incloſed within the meſhes of the plexus, or great conjunction of nerves, which go to the arm, ſurrounded alſo by all the veins of the arm, which twine round it in a wonderful manner. Here it gives off the thoracic arteries to the thorax, and the ſcapular arteries to the ſhoulder. In ſhort, the axilla itſelf is a complicated ſtudy; but in all that reſpects the arteries it may be made very eaſy and plain. But let the ſurgeon remember that it is only by a perfect knowledge of the arteries, a bold ſtroke of the knife, and a maſterly uſe of the needle, that the patient is to be ſaved from bleedings after wounds hereabouts! for the old ſtory of compreſſing the axillary artery above the clavicle is now of no credit with any ſurgeon of knowledge or good ſenſe.

As the artery turns over the borders of the cheſt, it gives one or two twigs to the adjacent parts, as to the ſcaleni, and to the great nerves which lie over the artery, and to the ſerrated muſcle, where it lies under the ſcapula: but theſe branches are ſo ſmall that it is unneceſſary either to number or deſcribe them. The thoracic or external mammary arteries are the firſt important branches; they are four in number, and they are named after their place or office.

I. ARTERIA THORACICA SUPERIOR.

THE UPPER THORACIC ARTERY, being the firſt, lies of courſe deep in the axilla. It comes off about the place of the firſt or ſecond rib; it lies betwixt the leſſer pectoral and the great ſerrated muſcles; it gives its chief branches to theſe muſcles, and it alſo gives other branches to the intercoſtal muſcles and the ſpaces betwixt the ribs. But, upon the whole, it lies very deep, is ſmall, is ſo ſhort that the next is entitled thoracica longior; it is an artery of little note.

2. ARTERIA THORACICA LONGIOR.

THE LONG THORACIC ARTERY is more important, ſupplying all the great pectoral muſcles and the mamma. It was named the external mammary artery; but we are the more willing to change the name, ſince it has no likeneſs to the internal mammary artery; is in no reſpect a counter-part to it; it might be named the pectoral artery. It is long, not tortuous, but ſtraight and ſlender, and about the ſize of a crow-quill. It is needleſs to deſcribe an artery ſo variable in its branches as this is; it is ſufficient to ſay, that after giving ſmall twigs to the axillary glands, it terminates with all its larger branches in the pectoral muſcle, mamma, and ſkin, and in inoſculations with the intercoſtals and internal mammary; it is very long, deſcending ſometimes ſo low as to give branches to the oblique muſcles of the belly.

3. ARTERIA THORACICA HUMERARIA.

THE THORACIC ARTERY of the SHOULDER goes off from the upper and fore part of the axillary artery. Its place is exactly oppoſite to that of the mammaria ſuperior, viz. under the point of the coracoid proceſs, inſomuch that Haller has named it thoracica acromialis. It is a ſhort, thick artery; it burſts through the interſtice between the pectoral and deltoid muſcles, and appears upon the ſhoulder almoſt as ſoon as it comes off from the main artery; it reſembles the thyroid in ſhape, being a ſhort thick artery, terminating all at once in a laſh of ſlender branches, which go over the ſhoulder in various directions: but I never could obſerve any order worth deſcribing. One deeper branch goes to the ſerratus major, a branch goes along the clavicle, gives it the nutritious artery, and then goes on to the pectoral muſcle, and to the ſkin of the breaſt: it gives ſmall branches to the axillary glands, and larger ones to the deltoid and pectoral muſcles and ſkin of the ſhoulder, for this is very much a cutaneous artery. The chief branch is that which is laſt named, running down betwixt the deltoid and pectoral muſcles; and the moſt curious branch is a ſmall artery which accompanies the cephalic vein, and runs backwards along the courſe of the vein, a ſmall and beautiful branch.

4. ARTERIA THORACICA ALARIS.

SOMETIMES, though not always, there is a fourth thoracic artery. When it exiſts, we find it cloſe by the laſt artery; its branches, which are ſometimes numerous, belong entirely to the cup or hollow of the axilla; it goes to the glands and fat, and thence its name of ALARIS or AXILLARIS. This is the deepeſt or backmoſt of theſe mammary arteries; it attaches itſelf to the lower border of the ſcapula, and we often ſee it running along the lower border a conſiderable length, and giving branches chiefly to the ſubſcapularis muſcle.

THESE are the four mammary arteries which go to the breaſt. The arteries which go to the ſcapula follow next, and are only three in number; one, which is the counterpart of the ſupraſcapular artery, is the greateſt branch from the axillary artery, ſupplies the lower ſurface of the ſcapula, and thence is named SUBSCAPULAR ARTERY; one, which, as it is reflected round the joint by the outſide, is named the EXTERNAL CIRCUMFLEX ARTERY; and one, which, as it turns round the inner ſide of the joint, is named the INTERNAL CIRCUMFLEX ARTERY.

5. ARTERIA SUB-SCAPULARIS.

THE SUBSCAPULAR ARTERY is of a great ſize; it is hardly deſcribed in books, I might ſay is hardly known to anatomiſts. Douglas, and moſt eſpecially Sabbatier, have ſcarcely named it, though it is in fact one of the largeſt arteries in the body, being abſolutely as large as the axillary artery, from which it takes its riſe *.

The greateſt maſs of fleſh in almoſt any part of the body is that which lies under and around the ſcapula in a ſtrong man; and this artery ſupplies almoſt all that maſs. It goes off from the axillary oppoſite to the neck of the ſcapula, juſt under the long head of the biceps brachii: it no ſooner comes off from the axillary artery, than it attaches itſelf to the lower border of the ſcapula; and as ſoon as it comes to the edge of the ſcapula (but ſometimes lower down the edge, viz. where the head of the biceps comes off) it ſplits into two great branches; one of which goes to the upper, and one to the lower ſurface. But to deſcribe each little artery among ſuch a maſs of fleſh, or to expect to find them regular, would be very thoughtleſs; the general courſe of them only can be deſcribed. Firſt, The greater branch, which goes to the lower ſurface of the ſcapula, is the proper trunk of the ſubſcapular artery;

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* It is named often ſcapularis inferior or infra-ſcapularis; it is better named ſubſcapular, both to harmonize with the name ſubſcapular muſcle, to which it belongs, and alſo to contraſt with its counterpart, the ſupraſcapular artery, which comes from the ſubclavian artery.

artery; it divides into two great branches, which courſe all over the lower or hollow ſurface of the ſcapula: one of theſe is deeper, runs downwards along the naked border of the ſcapula, lies under the muſcles upon the flat bone, and ſupplies the inner ſurface of the ſubſcapular muſcle with many branches. It ſends a branch upwards, which runs along the inner ſurface of the neck of the ſcapula, runs ſtill forwards under the root of the coracoid proceſs, and its extreme branch goes round by the baſis of the ſcapula to make an inoſculation with the larger branch.

Secondly, The larger branch keeps nearer the ſurface, and ſupplies all the outer ſide of the ſubſcapular muſcle. Its general courſe is round the ſcapula, down the fore edge, then round by the lower angle, then up by the line of the baſis ſcapulæ, encircling it with what might be named a coronary artery. It firſt gives branches to the teres major; then paſſes down along that muſcle to the angle of the ſcapula; then turning along the angle of the ſcapula (which it does not do without leaving many branches behind), it runs in a waving line all round the baſis ſcapulæ, till it arrives at the upper corner, where it ends in free inoſculations, both with its own deeper branch, and alſo with the ſupraſcapular artery which comes along the ſhoulder.

Now this great branch, with all its arteries, belongs entirely to the lower ſurface of the ſcapula; but the branch which leaves it at the neck of the ſcapula turns round under its lower edge, gets to the upper ſurface of the ſcapula, runs in under the infra-ſpinatus and teres major muſcles, betwixt them and the bone; and although the ſupraſcapular artery from the ſhoulder ſupplies chiefly the upper part of the ſcapula, yet it is chiefly above the ſpine that that artery circulates, while the lower parts of the Infra-ſpinatus and the Teres minor muſcles are left to be ſupplied by this reflected branch of the ſubſcapular artery: thus this reflected branch gives its arteries, firſt to the Teres, then it enters into the hollow under the ſpine, and beſides ſupplying the infra-ſpinatus and the bone itſelf, it alſo makes a circle, though a ſhorter one, and inoſculates with the ſupra-ſcapuralis, juſt as the other branch of this ſame artery does on its lower ſurface. This branch deſcends nearly to the corner of the ſcapula before it begins this inoſculating circle; but it ſends alſo another chief branch round the neck of the ſcapula, which advancing towards the ſupraſcapular notch, inoſculates very largely with the ſupraſcapular artery.

Thus is the ſcapula encircled, and ſupplied with a wonderful profuſion of blood by two great arteries; one, the SUPRASCAPULAR ARTERY, coming acroſs the neck, over the ſhoulder, and through the ſcapular notch; another, the SUBSCAPULAR ARTERY, which comes from the axilla to the lower flat ſurface of the ſcapula, and divides at the edge of the ſcapula into two great branches; one of which keeps ſtill to the flat ſurface, while the other turns over the edge of the ſcapula, and ſupplies in part its upper or outer ſurface.

6. ARTERIA CIRCUMFLEXA POSTERIOR.

THE POSTERIOR CIRCUMFLEX ARTERY is a very large one. It ariſes either along with, or immediately after, the great ſubſcapular artery; the place of it is of courſe ſettled by the place of the ſhoulder-joint, for it belongs ſo peculiarly to it that it is ſometimes named the Humeralis, ſometimes the Articularis, ſometimes the Reflexa Humeri. It goes off between the ſubſcapularis and teres major muſcles; it paſſes in between them to get to the joint; it then turns round the ſhoulder-bone, accompanied by the circumflex nerves, juſt as the ſupraſcapular artery is accompanied by the ſupraſcapular nerve; it ends, after having made nearly a perfect circle, upon the inner ſurface of the deltoid muſcle.

Its branches are, firſt, Twigs to the nerve which accompanies it, and to the capſule of the ſhoulder-joint.—Secondly, Branches to the coraco-brachialis and ſhort head of the biceps, and to the triceps, and a twig to that groove in which the tendon of the long head of the biceps lies.—Thirdly, It ſends large branches to the ſubſcapularis, to the long head of the triceps, &c.—And, laſtly, The artery, far from being exhauſted by theſe branches, goes round the bone, turns over the joint under the deltoid muſcle, and ends in a great number of branches, ſtill accompanied by branches of the nerve, which are diſtributed in part to the capſule, but chiefly to the lower ſurface of the deltoid muſcle, where it lies upon the joint.

7. ARTERIA CIRCUMFLEXA ANTERIOR.

THE ANTERIOR CIRCUMFLEX ARTERY, which goes round the fore part of the joint, bears no kind of proportion to that great artery which paſſes round the back. The anterior goes off from the ſame point nearly with the poſterior, or ſometimes ariſes from the poſterior itſelf; it takes a direction exactly oppoſite; it keeps cloſe to the ſhoulder-bone, paſſes under the heads of the coraco-brachialis and biceps; encircles the head of the os humeri juſt at the root of the capſular ligament, and goes round till it meets and inoſculates with the poſterior circumflex artery. I never could find thoſe muſcular branches which are ſaid to go to the ſcapula, or have found them very trivial; the whole artery belongs to the bone and its parts; it encircles the root of the capſule with a ſort of coronary artery; it gives twigs to the capſule, the perioſteum, and the tendons, which are implanted into the head of the bone; and having given twigs to the heads of the biceps and coraco-brachialis, it gives off its only remarkable branch, which is indeed regular and curious; it is a ſmall branch which runs down along the bone in the groove in which the tendon of the biceps lies.

CONCERNING the axillary artery in general, there is more to be obſerved than this occaſion will allow.

But theſe things muſt not be paſſed over in total ſilence. In the firſt place, the artery, as it paſſes over the border of the cheſt, and after leaving the arch of the clavicle, is felt beating, and there only can it be compreſſed.

The compreſſing of the ſubclavian artery with a tourniquet or with the thumb, attracted at one time ſo much attention, and incited ſo many to ſpeak about it, that it came to be thought important, and has been ever ſince eſteemed practicable; and yet even thoſe who have ſpoken the moſt confidently have taken the thing merely upon vague report, have neglected to read the proper books, have deſcribed the way of compreſſing as above the clavicle, not knowing that it ſhould be done below it. Camper, in his "Fabrica Brachii Humani," firſt mentioned what he had demonſtrated in his claſs, viz. that he could, by placing the thumb under the point of the coracoid proceſs, ſo compreſs the axillary artery againſt the ſecond rib where it lies upon it, that even the ſtrength of a ſyringe could not puſh an injection through it[*]. And thoſe

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[*] In cadaveribus plus ſemel in publico theatro monſtravi, comprimi poſſe integram arteriam; ligabam arteriam aortam infra arcum, reſecabam deinde axillarem dextram, ac ſiphone axillari ſiniſtræ adaptata fortiter aquam impellens, ſolo digito eo modo moderare potui ſubclaviam, ut ne gutta quidem efflueret: quod quanti momenti eſſe queat in amputatione humeri in articulo nemo non videt. In vulneribus ſclopetariis, aliiſque circa humeri articulum inflictis, ſanguinis profuſionem ſimiliter compeſcere, ſi non penitus ſiſtere poſſemus. Vid. *Camper*, lib. i. p. 15.—The plain reaſon why we are able thus

to

who learn things by hearſay, have ſaid that "the ſubclavian artery could be compreſſed by thruſting the thumb in above the clavicle;" although, in fact, the arch is ſo deep, the muſcles ſo ſtrong, and the artery ſo little expoſed, that this is abſolutely impoſſible.

From my ſpeaking with a ſeeming intereſt about the preference of one of theſe two places to the other, it may be thought that I believe this piece of knowledge uſeful: 'Quite the reverſe! I know it to be dangerous; I know it to be leſs practicable than authors report and believe; and I repeat what I ſaid on a former occaſion, that "it is eaſy to ſtop the pulſe of an artery, but quite another matter to ſtop the flow of blood through it." We thruſt down our hands and compreſſes, and reſt with our whole weight upon the artery; it ſeems ſtopped, becauſe the pulſe is ſtopped; but the firſt ſtroke of the knife ſhows us how far we are gone in a dangerous miſtake. I may ſay, without breach of confidence, that I have ſeen one gentleman truſt to it, who will never trouble himſelf about it again. He was a dexterous ſurgeon; and in a great aneuriſm of the axilla was deluged with blood at the firſt ſtroke of the knife, and ſaved his patient only by a plunge of the great needle.

Secondly, It is much to be lamented that we cannot really ſuppreſs the blood; not merely becauſe it

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to compreſs the artery in the dead ſubject is the want of reſiſtance in all the muſcles. If ever it be poſſible in the living body, it muſt be when the ſtrength is low, and the circulation very languid, after the patient has fainted with loſs of blood.

would make every wound leſs dangerous, but becauſe it would greatly facilitate operations which we are called upon every day to perform. Would it not be pleaſant if we could cut the cancerous breaſt without the loſs of blood? or ſearch into the axilla with perfect deliberation, and cut diſeaſed parts out with the knife, not tearing them in a brutal manner with our fingers? Yet ſtill, by ſtudying this piece of anatomy, the ſurgeon knows both from what ſource all the arteries which bleed upon the ſurface of the amputated breaſt come, viz. the long mammary artery; and alſo that in any very dangerous ſituation it would be eaſy to command all the bleeding orifices by one dip of the needle, the axilla being open. He alſo knows that the thoracica alaris and the ſhort thoracic artery ſupply all the glands, and that theſe lurk too deep in the axilla to be ſecured otherwiſe than by a compreſs: ſo that theſe arteries are in fact opened by tearing with the fingers, and are ſtopped by thruſting in a ſpunge. He knows alſo how many large arteries there are, eſpecially about the ſcapula, of which the bleeding muſt reſemble that of the axillary artery itſelf; he will judge of the nature of the wound by the pulſe; and he will act with great advantage in all doubtful caſes, by remembering theſe great arteries of the ſcapula, which either bleed outwardly moſt furiouſly, or if they ſeem to ſtop, it is only by filling the axilla with blood.

Thirdly, The connection of the artery with the axillary nerves, though it muſt be more fully deſcribed in another place, muſt yet be obſerved here as a relation too important to be omitted. The artery paſſes along with the nerves through the interſtice of the ſcaleni muſcles; the nerves, which conſiſt of no leſs than ſeven pairs, make by their mutual connections a ſort of net, which is called the plexus of the axillary nerves. This plexus has its meſhes formed, not by ſmall diviſions, but chiefly by the ſeven great cords. This broad plexus lies over the artery as it comes out from the cheſt; the artery perforates the plexus, or paſſes through one of the largeſt meſhes in the cavity of the axilla; and when we extend the arm, for example, to cut out an axillary gland, the great veins lie neareſt the knife, or loweſt in the axilla; the plexus of nerves next; and laſt of all the artery which has juſt perforated the plexus of theſe great nervous cords; three nerves are below the artery and two above; and when the arm is luxated, and the ſhoulder-bone puſhed downwards, the head of it is ſo preſſed againſt the net of nerves, and the artery is ſo compreſſed betwixt the head of the bone and the meſh of nerves, that I have very ſeldom failed to find the pulſe almoſt entirely ſuppreſſed in luxations of this kind.

This connection, viz. with the nerves, is a very intereſting one. It is plainly ſuch that the artery cannot be hurt without a wound of the nerves; it has never been known that the artery has been cut in the axilla without the arm being lamed by this wound of the nerves: alſo the nerves cannot be hurt without the artery being in danger; but it does eſcape ſometimes; of which, among other examples, this is one of the moſt ſingular.—I have ſeen the artery eſcape in wounds when the nerves were hurt; but how it could eſcape the ſtroke of a blockhead's needle in the following caſe, I am at a loſs to conceive. A Woman came to me with a great ſtring hanging in her axilla, and along with her came her ſurgeon. He had about three months before cut off her breaſt for a cancer, and moreover ſome glands from the axilla, from which there was a bleeding; and of courſe, as his fingers could not go deep enough, he took a needle proportionably large, ſtruck it down into the arm-pit, and tied all up. When he brought his patient to me, there hung from the arm-pit, not a ſurgical ligature, but a good large tape; the axilla was a large gaping and terribly fetid ulcer; I paſſed my finger into it, and felt the arteries beating around it, and the tape firm about ſome cord of nerves, whether one or more I could not tell; the Woman's fingers were as crooked as a bird's talon, and her arm hung by her ſide quite uſeleſs and lame. I made the ſurgeon feel the nerve with his finger, and offered to cut out the ligature ſafely; but he carried away his patient, that he might, though at a long interval, finiſh the operation himſelf.

The breaſt had been long healed, and the cord acted as an iſſue in the axilla. How near the edges of this needle muſt have been to the great artery, it is terrible to think; and it is moſt providential that ſuch accidents do not happen daily, conſidering how much this crooked needle is uſed in deep places, where it is leaſt fit to be uſed.

III. OF

III. OF THE BRACHIAL ARTERY.

The brachial artery is that diviſion of the artery which is marked by the tendon of the great pectoral muſcle; for as that is the fore border of the axilla, all above that is axillary, and all below it brachial artery, down to the bend of the arm, where it divides into the radial and ulnar arteries. The brachial artery runs cloſe along the os humeri on its inner ſide, here the bone is moſt naked; and this is the line in which we feel the artery beating, and apply the cuſhion of the tourniquet.

To deſcribe, as ſome authors have done, each inſignificant and nameleſs branch which this artery gives off, were to make a ſimple matter intricate beyond all enduring. The whole matter is this: As the artery goes downwards, lying exactly on the inner ſide of the arm bone, and directly in the middle betwixt the biceps on the fore part and the triceps behind, it gives frequent branches to each. Thoſe going to the biceps are ſhort, ſmall, pretty regular, and exceedingly like each other all the way down the arm; and they are thus frequent, and very ſhort, in conſequence of the artery adhering cloſer to the ſides of the biceps. Not one of them can be diſtinguiſhed, or is worth naming. Thoſe which it ſends downwards to the triceps are (in conſequence of that being a large muſcle, with ſeveral thick and fleſhy origins) both longer and more tortuous, and more important; and they accordingly have ſome of them appropriated names. Of theſe arteries going down towards the back part of the arm, and working their way among the muſcles, three chiefly are to be obſerved. Firſt, The arteria profunda ſuperior, which goes round the back of the arm to the exterior muſcles, and is often named the upper muſcular artery. Secondly, Another like it, called arteria profunda inferior, or the lower muſcular artery. Thirdly, The ramus anaſtomoticus major, which anaſtomoſes round the elbow with the branches of the ulnar artery. Theſe three chiefly deſerve notice.

I. ARTERIA PROFUNDA HUMERI SUPERIOR.

Those arteries, which in the limbs go deep among the fleſhy parts, as in the arm or thigh, have always one of two names, either profunda or muſcularis, and often both. The upper deep muſcular artery of the arm is about the ſize of a crow-quill, or larger; it goes off from the inner ſide of the brachial artery, juſt where the tendons of the latiſſimus dorſi and teres are inſerted: and very often it ariſes from the great artery of the ſcapula, or that of the joint, viz. the ſub-ſcapularis, or reflexa humeri.

The profunda turns downwards and backwards round the bone; it glides in betwixt the firſt and ſecond head of the triceps; there it divides within the thick fleſh of that muſcle into two chief branches, or the two branches ſometimes part immediately after their common origin, or ſometimes they go off apart from the humeral artery. One of theſe, perforating the biceps muſcle, turns quite round the bone; and Monro the Father, who gave us the name of ſpiral nerve, named this alſo, very properly, the muſcular ſpiral artery: ſo this artery alſo, as well as the ſupraſcapular and circumflex arteries, has its accompanying nerve. This long artery runs down the back and outſide of the arm; it deſcends quite to the outer condyle of the os humeri, and by branches round the olecranon, and over the outer condyle, it inoſculates very freely with the radial artery.

The other branch of the profunda ſuperior runs down the inner ſide of the arm, gives many branches to the triceps, and coraco-brachialis; gives a few alſo to the biceps and deltoid muſcle: its longeſt branch, the proper termination of the artery, runs downwards till it touches the inner condyle, as the poſterior branch does the outer condyle; and this inner artery communicates with the outer branch round the olecranon, making ſmall but frequent and beautiful inoſculations; and it alſo inoſculates over the condyle with the reflected branch of the ulnar artery. In ſhort, the profunda ſuperior turns down towards the back part of the arm, buries itſelf under the triceps muſcle, ſupplies all the fleſh of the triceps, and divides in the heart of that muſcle into two branches, both of which go down to the elbow-joint, and inoſculate; the one, round the outer condyle with the radial artery; the other, round the inner condyle with the ulnar artery.

2. ARTERIA PROFUNDA HUMERI INFERIOR VEL MINOR.

THE LESSER PROFUNDA, or the lower muſcular artery, is ſo named becauſe it reſembles the former in almoſt all points. It is ſmaller, being not half the ſize (viz. of a crow-quill), and goes off, in general, about two inches lower down the arm. Its courſe, alſo, is exactly ſimilar, except in this, that it is ſingle, does not divide into two branches; it gives twigs to the muſcles of the arm; runs down to the inner condyle, and after touching it, makes a ſudden and ſerpentine turn, by which it gets upon the back part of the elbow-joint. Its chief inoſculations are with the upper profunda, and with the recurrens interoſſea upon the back part of the joint.

Betwixt the upper and lower profunda there generally is ſent off that artery which is to nouriſh the bone. It is named ARTERIA NUTRITIA HUMERI; but is not of ſufficient importance to be numbered among the main branches of the artery. The nutritious artery ſends off ſmall branches, or rather ſmall twigs, to the brachialis, or that muſcle which lies under the biceps and to the triceps; and it perforates the bone about its middle in one larger artery, and ſometimes there are alſo one or two ſmaller ones.

3. RAMUS ANASTOMOTICUS MAJOR.

THE GREATER ANASTOMOSING ARTERY is one of three or four which anaſtomoſe round the elbow-joint: for as the humeral artery advances towards the bend of the arm, it begins about three inches above it, to give off ſidewiſe, and almoſt at right angles with the trunk, three or four ſmall arteries, more or fewer according to the ſize of the arm. Each of theſe ſends its little twigs round the condyle, to inoſculate with the arteries of the forearm both radial and ulnar. Among theſe one is diſtinguiſhed for its ſize and importance; it is one of the largeſt of theſe arteries, and thence named ANASTOMOTICUS MAGNUS; it ariſes from the Humeral artery about three inches above the joint; it lies cloſe by the ſide of the brachialis internus, and gives many branches to it and to the triceps; but it is chiefly expended in three branches, one of which turns backwards, and running up the arm gives branches to the muſcles, and inoſculates with the profunda; another goes downwards towards the middle of the bend of the arm, and gives branches to the pronator teres and the flexor digitorum; and then going deeper, it touches the capſule, and makes a beautiful inoſculation over the forepart of the joint with the radial recurrent or inoſculating artery: another branch, the moſt important, and the chief termination of the artery, runs down betwixt the olecranon and the condyle, in the hollow where the ulnar nerve lies. It firſt contributes to that net-work of inoſculations which covers the back of the joint over the olecranon; it inoſculates very freely with the recurrens ulnaris; and it is this inoſculation that gives the artery its importance and its name. This is the channel through which the blood goes after the operation for the aneuriſm, as we know from preparations; and I have ſeveral times felt for it, and found it after the operation, while the arm was ſtill very ſmall, having been waſted by the diſeaſe and by the ſuppuration.

I have not, in deſcribing theſe arteries of the arm, once mentioned the name of collateral artery; for it is a name which muſt be entirely dropped, becauſe it has been much abuſed. Sabbatier, Murray, Haller, and all the French and German anatomiſts, have named the arteriæ profundæ COLLATERAL ARTERIES; becauſe they lie alongſide of the great artery, running along with it down the arm. Douglas, and the Engliſh anatomiſts and ſurgeons, have called the three or four ſhort anaſtomoſing branches near the elbow the collateral arteries; becauſe, though they run off at right angles or obliquely from the trunk, yet they run parallel with each other. Dropping this name, then, we find no more than three arteries in the arm of any note: the upper or greater profunda, with its two branches; the lower or leſſer profunda; and the great anaſtomoſing artery.

OF THE ARTERIES OF THE FOREARM, VIZ. OF THE RADIAL, ULNAR, AND INTEROSSEOUS ARTERY.

THE place and condition of this artery at the bend of the arm is as intereſting as where it lies in the axilla; for while bleeding is allowed, or is practiſed by low and ignorant people, operations at this point muſt be more frequent than at any other, and muſt be eaſy or ſucceſsful only in proportion as the artery and all its relations is well underſtood.

The humeral artery ſtill continues an undivided trunk, much lower than the bend of the arm; though we are accuſtomed to name that as the place at which it divides. The whole arm, it muſt be remembered, is covered with a faſcia, and that faſcia lies over the artery; but at the bend of the arm there is a peculiar faſcia, or at leaſt the round tendon of the biceps ſo ſtrengthens the general faſcia, by ſending a broad expanſion obliquely acroſs the bend of the arm (which faſcia is fixed into the condyle and down the edge of the ulna), that we call this expanſion peculiarly the tendon of the biceps, and ſay that the artery is at the bend of the arm covered and protected by the tendon of the diceps muſcle. The condition then of the artery is ſhortly this: It comes from the inſide of the arm, inclining all along towards the middle of the bend or folding of the forearm; there, without any particular ring or aperture for its admiſſion, it paſſes under the aponeuroſis of the biceps muſcle; for the aponeuroſis of the biceps and of the arm in general are one continued ſheath. When thus lodged behind the tendon, it lies in a deep hollow betwixt the flexors and extenſors of the arm, or, in other words, betwixt the muſcles of the upper and of the lower edge; the tendon of the biceps covers this triangular hollow; the floor or bottom of it is the coronary proceſs of the ulna and the forepart of the elbow-joint, and there the artery lies imbedded in cellular ſubſtance, encircled by thoſe veins which accompany the artery particularly, and which are thence named venæ comites; and it carries along with it a nerve in diameter equal to itſelf, and this nerve is named the great radial nerve.

The artery does not divide immediately, even after it has thus paſſed the bend of the arm, but goes down deep among the fleſh of the forearm, and there divides; the ulnar artery being lodged under the thick fleſh of the pronator and flexor ſublimis muſcles, and the radial artery under the ſtrong fleſhy belly of the flexor radialis and of the ſupinators, not abſolutely within their ſubſtance, but under cover of their fleſhy bellies, which ſwell out into a great thickneſs at this part of the arm. The only part of the artery which is expoſed, the point which we feel beating, is that where the ſingle and undivided trunk firſt begins to paſs under the thicker faſcia of the biceps muſcle; and there the artery is puſhed forwards, raiſed, and made to appear ſuperficial by the projection of the coronoid proceſs and brachialis muſcle, or, properly ſpeaking, by the protruſion of the forepart of the elbow-joint. This is juſt before it ſinks into the triangular hollow betwixt the muſcles.

This artery is ſingular in one kind of luſus naturæ, which never happens, nor any thing ſimilar to it, in the lower extremity, viz. that the trunk of the artery forks into two great branches high in the arm; ſometimes in the axilla, but oftener in the middle of the arm, or opoſite to the pectoral muſcle: and I have conſtantly obſerved, when this happened, that the radial artery was, as it were, the accidental branch, and paſſed acroſs the arm near the bend of the elbow, ſo as to traverſe the ulnar or main artery; and that the radial artery paſſes quite on the outſide of the faſcia, which binds down the ulnar or main branch of the artery.

This ſhort deſcription involves many points which the ſurgeon ſhould think of, and more than can be touched upon in this place. The following conſequences certainly follow from this arrangement of parts.

Firſt, The artery lying thus deep under the biceps, cannot be hurt by any ſkilful ſurgeon, though bleeding the very vein under which it beats, and at the moſt critical point; it is hurt, as far as I have obſerved, only by the rudeſt ſtroke of very ignorant fellows; I have ſeen in ſix caſes a wound in it little leſs than a quarter of an inch in length. In one of the operations I found it abſolutely transfixed; the blood had been poured out from the orifice behind; I felt with ſurpriſe the artery running over the tumor, not under it; and having opened the ſac, I paſſed a probe through the artery from ſide to ſide.

Secondly, Since the artery divides only after it has gone deep, where its great branches are protected by the muſcles of the forearm, the trunk only is wounded in bleeding; the branch is never wounded; and we cannot but be ſurpriſed that Hunter, Haller, Sharp, and others, who ought to have ſtudied this point, believed it to be ſometimes at leaſt wounded in one of its branches; nor can we think, without ſurpriſe, of the arteries being ſo little underſtood in the time of Dr. Monro the Father, that he is forced to argue the propriety of doing the operation of aneuriſm from this fact, "That though it were dangerous to truſt to the common anaſtomoſis round the elbow, yet it ſometimes happens, that the two branches of the radial

dial and ulnar are ſet of in the axilla." This ſurely muſt have been but a cold aſſurance to the ſurgeon in thoſe days, viz. that he was to truſt chiefly to the chance of a luſus naturæ for the ſucceſs of one of his greateſt operations.

Thirdly, It muſt follow, ſince the artery lies behind the faſcia, and is wounded through it, that the blood, being poured out behind the faſcia, muſt raiſe it into a hard, firm, and (in time) inelaſtic tumour, growing every day firmer and harder. If ſurgeons will but think of this, they will go through their operation more correctly. It makes a point of vaſt importance in the deſcription of aneuriſm, ſince it gives outwardly the true character, and inwardly the true ſhape and appearance of the tumour, when the operation is begun, the outward inciſion being performed. Had it been but attended to rightly, what noiſe and wrangling might it not have ſaved about the nature and names of the diſeaſe (yet ſtill the older ſurgeons knew and deſcribed this piece of anatomy, though they made but a poor uſe of it)? and what idle and ſtupid deſcriptions might it not have prevented, ſuch as we have never ſeen in ſurgical books till now, of diffuſed aneuriſm, and the operation for diffuſed aneuriſm; when in truth the firſt ſtroke of the knife ſhows it to be a tumour very different from that which ſuch names, and ſuch formal diviſions, and old faſhioned deſcriptions muſt convey? The cup of an aneuriſm is the triangular hollow which I have deſcribed, and the bag of the tumour is the extended faſcia.

Fourthly, The courſe of this double artery tempts me to believe, that in thoſe few caſes where the blood of an aneuriſm was truly diffuſed, where it was an ecchymoſis, where the blood was not confined by the faſcia, but poured out under the ſkin, and driven upwards to the ſhoulder, and downwards to the fingers, giving the whole arm the appearance of mortification; that in ſuch rare caſes, there muſt have been a high diviſion, and that the preternatural artery had been wounded, for it lies above the faſcia, it is lodged in no hollow, ſuch as might receive its blood, nor covered by any membrane which might confine it: but at all events, I am perſuaded that Hunter is wrong in ſuſpecting that, ſince the pulſe ſo ſeldom returns inſtantly, this preternatural artery and the true one muſt be often tied together; for if the preternatural artery were wounded, it would be a very diffuſed aneuriſm, under the ſkin and above the faſcia; but the main artery would be found in its place, under the faſcia, quite ſafe; whereas, if the true artery were wounded, the tumour would be under the true faſcia, the preternatural artery would croſs by the ſide of the tumour, or over it, and the wounded artery being at the bottom of its own tumour, the two arteries would be ſix inches apart. Beſides, the neceſſity of ſuppoſing this is not ſo ſtrong as Hunter believed; I have ſeen the pulſe return during the dreſſing of the arm, when the diſſection was ſo wide and free that I am ſure there could be no luſus naturæ, but one artery dividing in the common place.

Fifthly, The cloſe connection of the artery with the great radial nerve muſt always be conſidered in all wounds at the bend of the arm; and eſpecially it conſtitutes a difficulty in the operation of aneuriſm, of which authors of great eminence have ſpoken far too lightly; and ſurgeons of character have tied it in with their great ligatures, as if for amuſement, or that they might ſee what would enſue. But, as I have ſaid on another occaſion, " a man muſt ſhow me either ſome poſitive neceſſity for doing this, or ſome poſitive good conſequences which will reſult from it, before I admit him to argue about the bad effects which may enſue." Will any man perſuade me, after the caſe which I have juſt related, that it is good or harmleſs to tie in the largeſt nerve of the arm? We ſee by that caſe, that the ligature's remaining firm in its place for three months is one of the leaſt of the ill conſequences, and the others may eaſily be conceived. Of theſe ill conſequences I have ſeen more than I will venture to tell.

THE humeral artery having left this moſt critical point at the bending of the arm, divides into three great branches, the radial, ulnar, and interoſſeous arteries; at leaſt the ulnar gives off the interoſſeous ſo ſoon, and the interoſſeous is ſo large, and has ſo pointed a deſtination, that I take the privilege of deſcribing the three branches apart. The ULNAR ARTERY, which we muſt regard as the continuation of the main artery, makes its way through the thickeſt fleſh of the forearm, goes along the ulnar edge of the arm, appears again from under the fleſh, about three or four inches above the wriſt; it goes down to the root of the little finger, and gives the chief arches in the palm of the hand, and all the arteries of the fingers, ſaving only the inner ſide of the fore finger. The radial artery goes off like a branch from the ulnar, or, in other words, the ulnar ſeems to continue in the courſe of the main artery, while the radial goes off to one ſide; it makes its appearance as a ſuperficial artery much higher in the forearm than the ulnar does; its chief branch turns backwards over the wriſt, or root of the thumb, and it gives all the arteries of the thumb and forefinger, as the ulnar does of the other fingers. The interoſſeous, again, is truly a branch from the ulnar; it comes off where the ulnar lies deepeſt; it runs along the interoſſeous membrane, whence its name; it belongs to the deep muſcles of the arm; it ſcarcely paſſes the wriſt, or at leaſt mounts but a very little way along the back of the hand.

Theſe are the great diviſions of the artery; but before entering upon theſe, it will be well to ſet apart and deſcribe one particular ſet of arteries, viz. the recurrents; both becauſe they belong in a peculiar manner to the joint, and becauſe the recurrents, from whichſoever of the great arteries they come, ſtill ſerve the ſame office, viz. of inoſculating with thoſe from the above joint; though, after all, this part of their office attracts our attention, chiefly becauſe we depend upon theſe inoſculations for our ſucceſs in operations for aneuriſm, though unqueſtionably the chief uſe of theſe arteries is to ſupply the joint and adjacent parts; and their inoſculations are but a ſecondary office.

ARTERIÆ RECURRENTES.

THE recurrent arteries are ſmall arteries correſponding with the anaſtomoſing arteries from above. They turn quickly backwards almoſt as ſoon as they are clear of the main arteries from which they ariſe: they encircle the whole joint, for they are no leſs than four, or ſometimes five, in number; one from the radial, two from the ulnar, and one from the interoſſeous artery.

RECURRENS RADIALIS ANTERIOR.

THE ANTERIOR RECURRENT of the RADIAL artery is the firſt branch which it ſends off, excepting a ſmall branch to the ſupinator and ſkin. The place where the radial recurrent is to be found, is deep in the hollow betwixt the brachialis internus or muſcle of the arm, and the extenſor radialis or firſt muſcle of the forearm, viz. that which conſtitutes its outer edge. The recurrent lies upon the forepart of the joint, where the outer condyle is: the muſcles which lie over this recurrent artery, or near it, are the two flexors of the wriſt, the ſupinator longus, and the biceps, and theſe receive its firſt branches; and one of its branches runs down along the tendon of the ſupinator. Its next branches go leſs regularly to the other muſcles of the forearm, as to the pronator teres, and to the flexors of the fingers; it has one SUPERFICIAL ANASTOMOSING artery, whoſe anaſtomoſes are not upon the naked joint; but, on the contrary, the branch mounts along the forepart of the brachialis internus muſcle, and inoſculates under the biceps with the leſſer or lower profunda. A ſecond anaſtomoſing branch goes deeper; it paſſes through the fleſh or belly of the brachialis, and anaſtomoſes with the ramus anaſtomoticus major from above. A third anaſtomoſing branch is the chief branch; it lies deeper ſtill upon the forepart of the joint, in the hollow which I have lately mentioned: it runs up under the belly of the ſupinator, along the forepart of the ſhoulder-bone, where it inoſculates with the upper profunda humeri, and chiefly with its greater branch called ſpiral artery; which turns round the bone, and ends here over the outer condyle.

This is the recurrens anterior of the radial artery; but none of theſe branches have I ever ſeen or felt to be enlarged after operations for aneuriſm. The ſucceſs of that operation depends entirely upon the arteries next to be deſcribed, viz. the ulnar recurrents, which are always two in number; but ſometimes theſe two recurrents go off in one branch from the ulnar: in which caſe, viz. of a ſingle recurrent coming off from the ulnar, it divides immediately into two branches, and the one takes the fore and the other the back part of the joint.

RECURRENS ULNARIS ANTERIOR.

THE ANTERIOR RECURRENT of the ULNAR artery goes off the firſt of the branches, immediately before it gives off the interoſſeous, and where the artery lies deep in its triangular hollow. This anterior artery paſſes up under cover of the pronator teres, lies cloſe upon the forepart of the inner condyle, and is of importance, not only by its own ſize, but alſo by its anaſtomoſing with the ramus anaſtomoticus major, which is the largeſt of the arteries from above.

RECURRENS ULNARIS POSTERIOR.

THE POSTERIOR RECURRENT of the ULNAR artery is often a branch of the anterior one, coming off with it in one common trunk. When it comes off apart, it ariſes a little lower; it is a larger and ſtronger artery, i. e. it makes as full inoſculations, goes farther, and gives more branches to the muſcles. This poſterior recurrent ariſes from the ulnar at that place where it perforates the bellies of the flexor muſcles; it alſo dives through betwixt the two bellies of the flexor muſcles of the fingers, it thus gets round the condyle, for theſe two muſcles ariſe together, from the condyle: the artery gives many branches both to the pronator and flexor muſcles, and to the perioſteum, and capſule of the joint; it then lodges itſelf in that deep hollow which is betwixt the olecranon and the condyle, where the ulnar nerve lies (that nerve which we feel ſo benumbed when we ſtrike the inner ſide of the elbow). The artery ſtretching upwards along the bone, meets a ſimilar deſcending branch from the upper profunda, and inoſculates with it. As far as we yet know, the whole weight of the buſineſs in ſaving the arm after aneuriſms depends upon theſe two arteries. In Mr. White's preparation it is the anterior branch which is enlarged, inoſculating with the anaſtomoticus major over the forepart of the inner condyle. In a preparation which I have, it is the poſterior artery which runs tortous and enlarged behind the inner condyle: but I muſt add to the authenticity of this preparation, by noticing, that I have ſeveral times felt diſtinctly, after ſucceſsful operations for the aneuriſm, that it was this poſterior artery that was enlarged.

RECURRENS INTEROSSEA.

THE RECURRENT of the INTEROSSEOUS artery is the firſt of its branches, though ſometimes this recurrent riſes from the ulnar a little above the interoſſeous. This artery going to the middle and back part of the joint is very conſtant; it firſt ſends one ſmaller branch forwards towards the root of the brachialis internus muſcle, which inoſculates over the forepart of the joint with the ramus anaſtomoticus magnus, and with the ulnar and the radial recurrents; but theſe inoſculations and this anterior branch are of ſmall importance. The chief branch goes through that lacerated-like hole which is in the upper end of the interoſſeous ligament; and the artery having paſſed through this hole, and got to the back of the joint, it runs for two inches upwards along the back of the olecranon, contributing greatly to form, by its inoſculations with both branches of the profunda ſuperior, that net-work of arteries which covers all the back-part of the joint, and which belongs chiefly to the joint, to the capſule, and to the bones which form the joint.

From theſe anaſtomoſing branches which belong to all the three arteries, we now return to deſcribe the general courſe of the three great arteries; and firſt of the radial.

ARTERIA RADIALIS.

THE RADIAL ARTERY is properly the firſt branch of the ulnar; it goes off from it at a pretty obtuſe angle in the bend of the arm; it paſſes under the pronator muſcle, emerges from under it above the middle of the arm, follows the long tendon of the ſupinator, and runs under it down to the root of the thumb; it is at the root of the thumb only that it divides into its great branches: and a clear proof that in its courſe down the forearm it gives off none but ſmall and irregular muſcular branches, is this, that it preſerves almoſt an equal diameter in all its progreſs from the elbow to the wriſt.

This is the artery which lies naked upon the radius at the wriſt, where we feel the pulſe. It lies more ſuperficial, leſs imbedded in muſcles, than the ulnar artery; for ſix inches above the wriſt there is to be felt nothing but the naked artery, the ſharp tendon of the ſupinator, and the bone. The radial artery, as to its courſe down towards the wriſt, is direct; but with regard to itſelf, it is tortuous, with ſhort and gentle wavings. Of its branches, as it moves down the forearm, there is not one that is worthy to be named. Firſt it gives a branch to the ſupinator, and to the extenſors of the carpus; then it gives the radial recurrent, already deſcribed; then having gone a little deeper among the muſcles, it repeats its branches to the ſupinator and extenſors; but being deep, it gives alſo twigs to the pronator and to the flexor radialis, inoſculating with the interoſſeous arteries. Next the radial artery, emerging from among the thickeſt of the muſcles of the forearm, becomes ſuperficial, touches the naked radius, and runs along it, with the belly of the flexor pollicis below it and the long tendon of the ſupinator above it. Here are no muſcles lying on the outſide of it, nothing but the tendon; and therefore all its twigs are downwards to the flexor pollicis, upon which it lies; to the flexor digitorum, which lies next to that; and to the flexor radialis and the palmaris longus. Next it gives deeper branches, viz. to the pronator quadratus; and alſo it gives ſmall twigs, which accompany the ſeveral tendons along the naked bone. Arrived at the wriſt, it does not divide, as authors have repreſented, into two branches, viz. a palmar and a dorſal artery, but quite the reverſe; the radial artery paſſes on undivided to the root of the thumb, and there divides into three great branches; one to the thumb, one to the forefinger, and one to the palm of the hand: it does indeed, while it is paſſing the wriſt, give two conſiderable branches, one to the palm, and one to the back of the hand; yet they are but branches.

ARTERIA SUPERFICIALIS VOLÆ.

THE firſt branch, then, of the radial artery, after arriving at the wriſt, is that which goes acroſs the palm of the hand, and may be named the SUPERFICIAL artery of the PALM. It goes off juſt where the main artery

tery is about to turn over to the back of the hand; it paſſes in general through the fleſh of the thumb, going under the root of ABDUCTOR BREVIS POLLICIS. This artery we generally find dividing into three branches: The firſt is a more ſuperficial branch, which croſſes the palm of the hand, and gives its twigs to the ſkin, palmar aponeuroſis, annular ligament, and all the tendinous parts about the joint: The ſecond is a larger and more important branch; it is the middle branch of theſe three; it goes deep; and having given ſeveral branches to the muſcles about the root of the thumb, and to one or two of the interoſſei muſcles, it makes a large inoſculation with the great palmar arch, which ſeems to be indeed the chief tendency of the whole artery: The third branch is leſs regular than the others; it mounts along the root of the thumb, and belongs to its outer edge *.

The next branches of the radial artery are very ſmall and nameleſs twigs, which go to the naked part of the wriſt, to the tendons, ligaments, and the bones; and then comes the artery oppoſite to this artery of the palm, viz. the artery of the back of the hand.

ARTERIA DORSALIS CARPI.

THE ARTERY of the BACK of the HAND comes of from the radial, juſt after it has turned over the root

* This branch anatomiſts have thought fit to call ARTERIA ULNARIS RADIALIS POLLICIS, which involves ſuch a complication of contradictions, that, upon reading it, one would naturally turn to the table of errata. The artery is called radialis, becauſe it comes from the radial artery; and ulnaris pollicis, becauſe it goes upon the ulnar ſide of the thumb.

of the thumb. It takes its courſe directly acroſs the back of the hand, over the carpal bones; and by its frequent inoſculations with branches from the ulnar artery, and with the interoſſeous arteries, it makes beautiful net-works acroſs all the naked part of the back of the hand. After this beautiful net-work, it ſends twigs forwards, which lie cloſe upon the bones, go to the muſcles which lie betwixt the bones. The muſcles are named interoſſei, and theſe twigs are named after them.

The firſt interoſſeous artery is large, long, goes up in a direct courſe to the fork betwixt the fore and mid fingers, and plunges into the cleft of the digital artery at right angles with it. The dorſalis manus gives then a ſecond twig like this, and then a third; named the firſt, ſecond, and third interoſſeous arteries: but they are all ſmaller than the firſt, and all the three communicate with the arteries from the palm.

Before the final diviſion of the radial artery * into its three branches, it gives a third artery, or, as often happens, two arteries, to the back of the thumb.

ARTERIA DORSALIS POLLICIS.

THE ſmall artery, or the two ſmall arteries which, from going along the back of the thumb, are named arteriæ dorſalis pollicis, come off either along with, or

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* Notwithſtanding the inconſiſtency of retaining the name of radial artery, after the artery has paſſed the wriſt, and begun to run along the thumb, I venture to ſacrifice verbal accuracy, and would make much greater ſacrifices to obtain a clear arrangement.

immediately after, the dorſalis carpi. When there are two, they run both along the back of the thumb, one on one ſide, the other on the oppoſite ſide; that which runs along the outer edge of the thumb paſſes through under the tendons, and is rather ſhorter; that which inclines to the inner ſide of the thumb is rather longer. Theſe ſmall arteries on the back inoſculate round the edges of the thumb with the great artery on the inner ſide; which is next to be deſcribed.

The radial artery having advanced to the wriſt, turns quick round the wriſt, over the head of the radius, and under the tendons of the thumb; it gives immediately before it paſſes the artery of the palm; it gives immediately after it paſſes the artery of the back of the hand; it gives immediately after that the little arteries for the back of the thumb; it then mounts along the thumb in that hollow which is by the ſide of the metacarpal bone of the thumb, till it arrives at the cleft betwixt the thumb and forefinger. There it divides into three great arteries; one to the inner ſide of the thumb, very large; another to that ſide of the forefinger which is next the thumb, which branch is much ſmaller; and one which exceeds theſe in importance, for it dives down into the palm of the hand, forms what is called the deep arch of the palm; and which, having croſſed the palm, forms on the ſide next the little finger that inoſculation betwixt the upper and lower arches which is ſo much celebrated.

ARTERIA RADIALIS INDICIS.

The artery of the forefinger proceeding from the radial artery is the firſt and ſmalleſt of theſe three branches. It goes off at the root of the metacarpal bone of the forefinger, goes up along its interoſſeous muſcle, and runs along all the edge of the forefinger next the thumb, inoſculating with the artery of the oppoſite edge, which comes from the ulnar arch; it ſends off twigs at its root, which inoſculate with the ſmall dorſal arteries of the thumb; and it gives a branch to the adductor indicis.

ARTERIA MAGNA POLLICIS.

The chief artery of the thumb riſes along its metacarpal bone, a ſingle artery, and there ſplits commonly, I think, into three ſmaller branches. Two of theſe run along the forepart of the thumb up to its extremity, and inoſculate there; the one running along the radial, the other along the ulnar ſide, till they meet at the point. Theſe are, as it were, counterparts of the dorſal arteries, but greatly larger, the thumb being naked on the back, but fleſhy where it looks towards the palm. Another branch of the arteria pollicis is one which turns acroſs to the palm of the hand, and makes a ſmaller and more ſuperficial inoſculation with the palmar arch.

ARTERIA PALMARIS PROFUNDA.

The third branch of the radial artery, and that by which it ends, immediately ſucceeds the artery of the thumb. It croſſes the palm of the hand ſo as to form the deep arterial arch, or the radial arch of the palm; it lies under the aponeuroſis, and all the tendons and muſcles cloſe upon the metacarpal bones. Having gone its circle ſo as to complete the arch, and having arrived at the root of the little finger, or rather lower, near the piſiform bone, it turns backwards with a ſudden ſerpentine turn, and enters into the ſide of the ulnar arch, ſo as to make a complete inoſculation.

This deep palmar arch gives out many arteries; but as it lies cloſe upon the bones, they are all of the ſmalleſt order of arteries, and go only to the bones, and to the joints of the carpus and metacarpus. Thoſe branches again which run upwards, give little arteries to the interoſſei muſcles, to the lumbricales, to the long tendons, and to the interſtice of each bone. Small twigs are ſent through to the back of the hand, which are named arteriæ perforantes, and which inoſculate with the dorſalis carpi, or artery of the back of the wriſt; they alſo inoſculate with the arteries of the fingers.

ARTERIA ULNARIS.

The ulnar artery, both from its ſize and its direction, is to be conſidered as the continued trunk. It dives downwards and backwards into the triangular

gular hollow which has been deſcribed, till it touches the interoſſeous membrane: It firſt gives off a ſmall branch to the pronator teres and common origin of the flexor muſcles, before it paſſes through them: Sometimes it gives off here the recurrent, which ſhould come from the interoſſeous artery; in which caſe that branch, as it paſſes backwards through the interoſſeous membrane, is named interoſſea poſterior ſuprema. Next the ulnar gives off the proper interoſſeous artery, which is named INTEROSSEA COMMUNIS, becauſe both the anterior and poſterior arteries are branches of it. Then the ulnar artery, lodged deep under all the muſcles which go off from the inner condyle, as the palmaris, pronator teres, flexor ulnaris, &c. perforates one of them, viz. the flexor digitorum. But though it paſſes through betwixt the upper and lower flexor, it does not, like the radial, appear immediately as a ſuperficial artery; it ſhows itſelf only about three inches above the wriſt. The ulnar artery, running along by the tendon of the flexor carpi, turns over the wriſt at the piſiform bone; it then forms the ſuperficial arch of the palmar arteries, and ſupplies all the fingers, as the radial ſupplies the thumb.

The arteries which the ulnar gives out after it paſſes through the muſcles, and before it arrives at the wriſts, are merely muſcular branches, extremely variable in ſize and number. To enumerate theſe would be but to repeat the names of all the muſcles which lie upon the flat part of the forearm.

As the radial ſends a branch over the back of the hand, named dorſalis radialis, ſo does this ſend a branch round the back of the little finger named dorſalis ulnaris.

ARTERIA DORSALIS ULNARIS.

THE DORSALIS MANUS ULNARIS is a ſmall branch which goes off from the ulnar artery as it advances towards the wriſt. The ulnar artery goes forwards towards the piſiform bone, while this little artery turns off about two inches below, paſſes under the tendon of the flexor ulnaris, and round the head of the ulna, to the back of the hand; it then goes upwards along the back of the little finger, where it ends. It gives branches as it paſſes along to the pronator quadratus, to the extenſor ulnaris, to the joints about the lower part of the wriſt, and eſpecially to the joining of the radius with the ulna; and it finiſhes on the back of the hand by arteries given to the tendons and capſule, by inoſculations with the rete which is formed upon the back of the wriſt, by the radial artery, and by giving the dorſal artery of the little finger.

Next the ulnar artery, before it begins its arch, gives ſmall branches to the flexor tendons and fore-part of the wriſt; others to the piſiform bone, to the annular ligament, and to the palmaris cutaneus, and then branches to the flexor, abductor, and adductors of the little finger; or, in other words, to all that maſs of muſcular fleſh which ſurrounds the root of the little finger; and ſtill, before it begins to bend into an arch, and juſt beyond the piſiform bone, it gives off that branch which may be called ARTERIA PALMARIS PROFUNDA.

ARTERIA PALMARIS PROFUNDA.

THE deſcription of this artery is ſhortly this: It is but a ſmall artery; it comes off a little lower than the piſiform bone; it often gives the laſt lateral artery of the little finger; it then turns downwards and backwards with a large circle, paſſes through betwixt the two heads of the flexor digiti minimi; by this it gets into the deepeſt part of the palm, and there joins itſelf with that palmar branch of the radial artery which comes off at the root of the thumb; and by this inoſculation the deep palmar arch is completed.

The ulnar artery having now arrived at the root of the metacarpal bones, forms a great arterial arch acroſs the palm of the hand, which is named the SUPERFICIAL PALMAR ARCH; and this arch gives out the arteries for the fingers after the following order: It does not give off two arteries to each finger, one for each ſide, becauſe it does not lie at the root of the fingers, but lower down: but inſtead of this it ſends out three ſingle arteries; each of theſe goes to the cleft betwixt two of the fingers; and when arrived at the roots of the fingers, theſe branches divide uniformly and regularly into two branches; of which one goes up along the ſide of one finger, while the other goes up the oppoſite ſide of the next finger; and thus all the fingers are ſupplied each with two arteries, one running along either edge of each finger. To number them according to the fingers one, two, three, were mere drudgery and waſte of time; and to name and deſcribe them were an abſolute abuſe, ſince they are ſo uniform in all points: It is ſufficient to obſerve, that a long and ſlender artery runs along each edge of each finger; that generally at each joint or diviſion of the finger the two arteries make arches to meet each other acroſs the hollow where the tendons lie, ſupplying the tendons and ligaments at the ſame time; and that the fork of each digital artery receives a branch from the deeper arch of the palm. That the arteries are each accompanied with correſponding nerves, one for each ſide of each finger; for the ulnar nerve accompanies the ulnar artery down the forearm, and branches along with it in the palm into the form of an arch, with three branches; which three banches are afterwards divided like the arteries, each into two twigs at the roots of the fingers.

The ſuperficial palmar arch finiſhes with a ſmall branch, which makes another inoſculation at the root of the thumb with that ſuperficial palmar branch which comes off from the artery of the thumb, near the place where the artery of the forefinger alſo comes off.

ARTERIA INTEROSSEA.

The interosseous artery is, after the radial and ulnar, the laſt of the arteries of the forearm. It is but a branch of the ulnar; it ariſes from the ulnar juſt where it lies in the very deepeſt part of the arm, touches the interoſſeous ligament. This artery is named interossea communis, becauſe of two leſſer interoſſeous arteries into which it divides. Firſt the interoſſea communis divides about an inch below the elbow into the interoſſea anterior and interoſſea poſterior; next the interoſſea poſterior gives off the poſterior or interoſſeous recurrent. That artery is already deſcribed; and I proceed to deſcribe now the courſe of the two interoſſeous arteries.

Firſt, The anterior interoſſeous artery is the continued trunk, for it goes ſtraight forwards, and is larger; while the poſterior interoſſeous is ſmaller, turns out of the ſtraight courſe to perforate the membrane, and is exhauſted before it reaches the wriſt.

The anterior interoſſeous artery lies flat upon the forepart of the interoſſeous membrane; is larger than a crow-quill, or about half the diameter of the radial artery. As it goes down the forearm, it gives branches to all the muſcles; it gives the nutritious arteries of the radius and ulna; it goes forwards, and, ending in ſmall branches under the anular ligament of the wriſt, it makes beautiful net-works and anaſtomoſis over the capſular joints of the carpus.

Secondly, The poſterior interoſſeous artery turns through the interoſſeous ligament about two inches below the elbow-joint. It inſtantly gives off the interoſſeous recurrent; which being very large, the artery ſeems to be divided into two equal branches, of which one is the recurrent, turning upwards towards the elbow-joint; the other is the poſterior interoſſeous itſelf, running downwards, and diſtributing its branches among all the great bellies of the extenſor muſcles which lie on the outſide of the forearm.

Thirdly, There is ſomething like a ſecond interoſſea poſterior; for the anterior interoſſeous artery ſends off, about four inches above the wriſt, another artery, but much ſmaller, which perforates the interoſſeous membrane; might be called a ſecond poſterior interoſſeous; though it is rather to be reckoned among thoſe ſmaller twigs which, coming off from the anterior interoſſeous, and perforating the ligament, go through it to the extenſor muſcles, and are named PERFORATING ARTERIES, being from about four to ſeven in number.

CHAP. III.

OF THE ARTERIES OF THE THORAX, ABDOMEN, AND PELVIS.

§ I. ARTERIES OF THE THORAX.

AORTA THORACICA.

THE aorta from the arch (where the ſubclavians and carotids go off) bends downwards and backwards, and touches the left ſide of the ſpine. The two membranes called pleura of the right and left ſide meet in the middle to form the mediaſtinum; but as they do not meet immediately, they leave a triangular ſpace, the baſis of which triangle is the ſpine; the ſides are the two membranes of the pleura, inclining towards each other; and there, in the interſtice betwixt them, the aorta is lodged, and along with it lies the œſophagus, which runs downwards towards the ſtomach. The thoracic duct, which is paſſing upwards to the ſubclavian vein, and the vena azygos, which returns the blood of the thorax, and brings it into the deſcending cava; theſe parts are all involved in cellular ſubſtance, and incloſed in this triangular ſpace betwixt the two membranes.

The aorta, as it goes thus downwards beſides the ſpine, gives the following branches: Firſt, As it lies immediately behind the root of the lungs, it gives ſmall arteries which nouriſh the proper ſubſtance of the lungs, the bronchial arteries: Secondly, As it lies by the ſide of the œſophagus, it ſupplies it with ſmall twigs, the œſophageal arteries: Thirdly, The aorta, as it moves downwards through the thorax, gives off a ſmall and regular artery to the interſtice of each rib as it paſſes it; and theſe are the INTERCOSTAL ARTERIES.

The BRONCHIAL arteries are always three, and ſometimes four, in number. Their office is not to contribute to the oxydation of the blood; that office belongs peculiarly to the pulmonic artery, while the ſmall bronchial arteries are for nouriſhing the proper ſubſtance of the lungs; for which end they attach themſelves immediately to the trachea, and follow its branches, twiſting round them through all the ſubſtance of the lungs.

I. ARTERIA BRONCHIALIS COMMUNIS.

THE COMMON BRONCHIAL ARTERY, ſo named becauſe it gives branches to both ſides of the lungs,

ariſes

ariſes higheſt from the forepart of the aorta; it gives two branches, one to the right ſide of the lungs, and one to the left; the right branch gives an artery to the œſophagus, and ſometimes the whole of the right branch goes to that part.

2. ARTERIA BRONCHIALIS DEXTRA.

THE RIGHT BRONCHIAL ARTERY ſometimes, like the common bronchial, comes off from the aorta; but very often it comes off from the upper intercoſtal artery. It goes round the right branch of the trachea, and belongs to that ſide of the lungs alone: but it gives, notwithſtanding, ſome branches to other parts, eſpecially to the œſophagus, to the back of the pericardium, and to the poſterior mediaſtinum, or membrane which ſtrides acroſs the aorta.

3. ARTERIA BRONCHIALIS SINISTRA.

THE LEFT BRONCHIAL ARTERY comes off along with the bronchialis communis from the forepart of the aorta; it goes to the left ſide of the lungs, and alſo affords ſmall branches to the œſophagus and neighbouring parts.

4. ARTERIA BRONCHIALIS INFERIOR.

OFTEN there is a fourth bronchial artery, which we would call BRONCHIALIS INFERIOR, or the LOWER BRONCHIAL ARTERY, becauſe it comes off lower than theſe, commonly about the place of the fifth rib. It goes to the back of the heart, where the pulmonic vein of the left ſide expands into the auricle, and taking the pulmonic vein as a conductor, creeps backwards along it into the ſubſtance of the lungs.

Theſe bronchial arteries are the leaſt regular in all the body, coming off uſually from the aorta, but ſometimes from the mammary, and often from the upper intercoſtal artery; ſometimes alſo they ariſe from the intercoſtals of the aorta. But from one or other of theſe ſources we uſually have three or four bronchial arteries, which are ſo named from their belonging to the branches of the trachea or bronchiæ.

Ruyſch, who firſt diſcovered this artery, and Sylvius de la Boe and others who followed Ruyſch, and uſed his words in deſcribing the artery, explained its office truly: they ſaid it was for nouriſhing the ſubſtance of the lungs. But this ſenſible opinion was diſputed by many phyſicians of very great reputation; who maintained that it was quite diſproportioned to the ſize of the lungs, and that it nouriſhed the trachea only; and they gave a moſt whimſical reaſon for believing all this. The lungs they conſidered as made of very coarſe ſtuff, which the half elaborated blood of the right ventricle and pulmonic artery might ſerve; while the harder and more perfect ſubſtance of the trachea required a more perfect and finer blood.

5. ARTERIÆ ŒSOPHAGEÆ.

THE ŒSOPHAGEAL ARTERIES are generally five or ſix in number. They are ſmall twigs which come off from the aorta below the bronchial arteries; they encircle the œſophagus, and make anaſtomoſes with each other; and very generally they paſs off from the œſophagus to the poſterior mediaſtinum, or that double membrane under the interſtice of which the aorta lies. Theſe ſecondary arteries, along with very ſmall twigs which come off from the aorta itſelf, ſome anatomiſts chooſe to deſcribe apart under the title of poſterior mediaſtinal arteries.

6. INTERCOSTALES INFERIORES.

THE LOWER INTERCOSTAL ARTERIES are nine or ten in number, according to the number of ribs which are not ſupplied by the upper intercoſtal artery (for the upper intercoſtal, which comes downwards from the ſubclavian artery, ſupplies uſually the intercoſtal ſpaces of the two firſt ribs), but ſometimes of three, and ſometimes of one only. The aorta, in its courſe down the back, gives out, as it paſſes each vertebra, one artery for each rib; as it goes down along the loins it ſtill gives off an artery at the interval of each vertebra; in the thorax they are named INTERCOSTAL, and in the loins the LUMBAR arteries.

The right intercoſtals are longer, becauſe they have to mount over the ridge of the vertebræ; the left ones are ſhorter, becauſe the aorta lies on that ſide of the ſpine: the intercoſtals often give ſmall twigs to the œſophagus and mediaſtinum; but beſides theſe, each intercoſtal artery gives three principal branches.

1. By the head of each rib it gives a ſmall artery, which belongs entirely to the ſpine, and this artery ſends one twig to the ſubſtance of each vertebra; another twig goes to the ſheath or dura mater of the ſpinal marrow; the third, following each intercoſtal

nerve backwards, enters into the ſubſtance of the ſpinal marrow itſelf.

2. Each intercoſtal gives next a larger artery, which perforates near the head of each rib, and paſſes through to the back, and ſupplies the longiſſimus dorſi, latiſſimus dorſi, ſacro-lumbalis, and all the great muſcles of the back, which have indeed no other ſource whence they can derive arteries; and though theſe are apparently ſmall for ſo great a maſs of muſcular fleſh, that ſmallneſs is compenſated for by their frequency.

3. The intercoſtal artery proceeds, after giving theſe branches, along its proper intercoſtal ſpace, where it gives an immenſe number of ſmall arteries to the intercoſtal muſcles; and as each artery paſſes round the thorax along the ribs, it ſplits into two branches; one attaches itſelf to the lower edge of the rib above it, where there is a ſort of groove to receive it, that is, the larger artery, and the artery which is to be feared in wounds or operations; the other attaches itſelf to the upper ſharp edge of the lower rib, where there is no groove; this of courſe is the ſmaller branch, much leſs important in all reſpects. Theſe two accompanying each rib, run round the circle of the thorax to its forepart, and inoſculate with the mammary and epigaſtric arteries.

§ 2. ARTERIES OF THE ABDOMEN.

AORTA ABDOMINALIS.

THE aorta deſcends into the belly under that arch which is formed by the legs of the diaphragm. It paſſes along the left ſide of the ſpine; but now, upon emerging into the abdomen, it inclines nearer to the middle of that ridge which is formed by the vertebræ. The flat and tendinous legs of the diaphragm not only ſtride over the aorta, ſo as to form an arch apparently for its protection; but the uppermoſt part of the crura turns flat under it, ſo as to embrace it. No vein goes along with the aorta; for the cava, which returns all its blood, leaves it a little above the pelvis, and inclines towards the right ſide, that it may enter into the right ſide of the heart, which it does by paſſing under the liver.

But the aorta has other very important connections; for as one of its firſt arteries is the great artery of the inteſtines, of courſe the root of the meſentery (the membrane which conducts the arteries of the inteſtines) lies over the aorta; and as the meſentery conducts the lacteals from the inteſtines, of courſe the meeting of the lacteals and of the lymphatics, or, in other words, the beginning of the thoracic duct, is at the ſide of the aorta. Again, as the great nerves which come down from the breaſt into the abdomen are deſtined chiefly for the viſcera, they have no other way of reaching the viſcera than by taking the direction of the ſeveral branches which the abdominal aorta gives out. There are three great branches; the cœliac, the ſuperior meſenteric, and the inferior meſenteric arteries. Of courſe there are three great plexus of nerves; the cœliac plexus, the ſuperior meſenteric plexus, and the inferior meſenteric plexus. As theſe net-works all come from the greater net-work which covers the aorta itſelf, that plexus is named, from its great ſize and from its many radiated nerves, the ſolar plexus; and the ſemilunar form of the two great nerves which ſupply the whole gives them the name of ſemilunar ganglions.

Theſe connections of the aorta, deduced in this general way, will be eaſily underſtood; will ſhow the importance of ſtudying this point, where there are ſo many intricate parts; and will explain alſo the neceſſity of mentioning this group of difficult parts at once.

The aorta then paſſes from the thorax into the abdomen, through betwixt the legs of the diaphragm; the beginning of the thoracic duct lies a little below this point, and the duct itſelf runs up by the ſide of the aorta; the great Splanchenic nerve, or that which goes to the bowels, attaches itſelf as ſoon as it enters the abdomen to the ſide of the aorta, and ſwells out into the ſemilunar ganglion or knot: So that the ſemilunar ganglion of each Splanchenic nerve lies along each ſide of the aorta; the ſmaller nerves which theſe ganglions give out meet acroſs the root of the abdominal aorta, to form the ſolar plexus; and next the cœliac and meſenteric plexus ariſe chiefly from that ſolar one.

The aorta, thus connected, having come out into the abdomen, the firſt branch which it gives off naturally is a ſmall one to the diaphragm as it paſſes under it. The next branch which it gives off is the moſt important of all, viz. the cœliac artery; and it ſupplies the ſtomach, the liver, and the ſpleen, becauſe they lie in the upper part of the abdomen. Next it gives a great artery to the inteſtines, which is named the ſuperior meſenteric artery; for it goes to the inteſtines which lie within the abdomen. And, laſtly, it gives off a great artery, which is named lower meſenteric; becauſe it ſupplies chiefly the lower part of the great inteſtines, and moſt eſpecially the rectum, where it goes down into the pelvis.

Then the aorta divides into the two iliac arteries, and of courſe has no longer the name of abdominal aorta.

ARTERIÆ PHRENICÆ.

THE diaphragm has in nine of ten bodies two arteries named the PHRENIC ARTERIES; one going to the right ſide, the other to the left. The varieties of this artery are too great almoſt to be mentioned; but, however, theſe are the chief: Generally the phrenic arteries are two ſmall arteries ariſing from the aorta, one going to the right ſide, another to the left; often there is one artery going off from the forepart of the aorta, and dividing immediately into two arteries, right and left; ſometimes one ariſes from the aorta itſelf, another from the cœliac artery; ſometimes the cœliac artery, which has properly but three branches, has a fourth added, which is the phrenic artery; ſometimes there are three phrenic arteries, ſometimes even four; and the diaphragm, it is always to be remembered, receives often ſmaller branches from the intercoſtal and lumbar arteries, or from the capſular arteries, beſides thoſe which it gets from the thorax along with its nerve coming along the pericardium.

Theſe varieties being mentioned, the hiſtory of the regular phrenic arteries may be very ſhort. One goes round the right ſide of the diaphragm, and the other round the left, with very little variety. Firſt the phrenic artery croſſes what is called the fleſhy part of the crus diaphragmatis of its own ſide, and goes bending along to what is called the ala or wing of the diaphragm, and gives a great many arteries in all directions into theſe fleſhy ſides of the diaphragm; the artery then turns round, and encircles the great central tendon, where the two phrenic arteries begin to turn round: they give one branch particularly large to the fleſhy ſides of the diaphragm, which ariſe from the ribs; then bending round the central tendon, they ſpread all their remaining branches forwards upon the central tendon, and upon that part of the muſcle which ariſes from the ſternum, and meet in large inoſculations with each other. One branch often pierces the diaphragm, goes into the pericardium where it is attached to the diaphragm, and unites with that artery which comes down along with the phrenic nerve, the comes nervi phrenici.

But ſtill it is to be remembered, that the phrenic arteries, before they enter into the diaphragm, give ſmall arteries to the capſulæ renales, and to the œſophagus and neighbouring parts; the œſophegean branch running upwards into the thorax, to inoſculate with the upper arteries of the œſophagus.

§ 3. OF THE ARTERIES OF THE STOMACH, LIVER, AND SPLEEN.

THE upper part of the abdomen is occupied entirely by the ſtomach, liver, and ſpleen; the ſtomach in the middle, the liver on the right hand, and the ſpleen on the left. The cœliac artery ſupplies all theſe parts; it riſes up from the forepart of the aorta a ſhort thick artery encircled by the leſſer arch of the ſtomach; and immediately ſplits into three branches, of which the middle branch goes to the ſtomach, the left goes to the ſpleen, the right goes to the liver; and thus we have all the branches of the cœliac artery neatly and ſimply arranged.

ARTERIA CŒLIACA.

THE CŒLIAC ARTERY is ſo important, that its place and connections muſt be more minutely deſcribed. It ariſes from the forepart of the aorta, juſt at that place where the aorta is cloſely embraced by the crura diaphragmatis, and over the eleventh vertebra of the back; it juts directly forwards, almoſt at right angles from the aorta, and is encircled by the leſſer arch of the ſtomach; the artery ſtanding up betwixt it and the diaphragm. The cœliac trunk, then, is ſo placed as to be ſurrounded by theſe parts; it has the œſophagus on the left hand; the lobulus ſpigelii, or lobulus papillaris of the liver, on the right hand; it has the leſſer arch of the ſtomach making its turn under it; and it has the diaphragm above, and the pancreas running acroſs below; it is covered by the delicate web of the omentum, named omentum minus, which goes from the leſſer arch of the ſtomach to the liver and to the ſpine.

Now this ſhort jutting out or ſtump we call the trunk of the cœliac artery; or we call it axis arteriæ cœliacæ, for there is no other artery of the body that divides like it: the ſtump, which is leſs than half an inch in length, ſerving as an axis, from which the three great branches, viz. to the ſtomach, liver, and ſpleen, go off all at once, in a tripod-like form; one upwards, one to the right, and one to the left. The hepatic, which goes to the right, is largeſt in the child, becauſe of the great bulk of its liver; the ſplenic, which goes to the left, is larger in the adult; the gaſtric is almoſt always the ſmalleſt of the three.

I. ARTERIA CORONARIA VENTRICULI.

THE CORONARY ARTERY of the STOMACH is the central artery of the tripod. When it belongs entirely to the ſtomach, it is ſmaller than the ſplenic or hepatic arteries: but when it gives (as often it does) a branch to the liver, it is the largeſt of the three. This gaſtric artery, or coronary artery of the ſtomach, is generally the ſmalleſt, not very much larger than a crow-quill; it riſes upwards, and turns a little towards the left ſide, becauſe the pyloric orifice of the ſtomach is there.

Before it reaches the pyloric orifice of the ſtomach, it divides itſelf into two great branches; one going round the cardial orifice of the ſtomach, and the other returning along the leſſer arch.

CORONARIA SUPERIOR VENTRICULI.

THE branch which belongs to the cardiac orifice of the ſtomach attaches itſelf to the œſophagus, juſt where it emerges from the diaphragm, and is joined to the ſtomach: the artery turns round the œſophagus, paſſes firſt under and behind it, and then turns round and appears on the forepart, or rather on the left ſide, of the ſtomach to ſpread over it. In the middle of this turn it gives off an artery which runs backwards along the œſophagus, takes directly the line of the œſophagus, runs up with it into the thorax a conſiderable way, inoſculates with the upper œſophagean arteries, and though a ſmall branch, it is long, and ſeldom awanting. The ſecond branch is a continuation of the ſame artery encircling the cardia, ſending its arteries down over the large and bulging part of the ſtomach, ſomewhat in the form of a crown. As the ſpleen is attached to this end of the ſtomach, this artery inoſculates with what are called the vaſa brevia, or ſhort veſſels coming from the ſpleen; and ſo it ends, having the name of CORONARIA SUPERIOR VENTRICULI.

The ſecond branch of the coronary returns along the leſſer arch of the ſtomach; it is ſo connected with the laſt that it may be called ramus coronariæ dextra, though properly it is not a branch, but the continued trunk of the gaſtric artery. As the firſt branch turns round behind the œſophagus, this ſtops and turns to the leſſer arch of the ſtomach, touches it juſt at the cardiac orifice, *i. e.* at the root of the œſophagus; turns with a gentle turn round the leſſer arch of the ſtomach, bending as the arch bends, giving its branches down both forwards and backwards over each ſide of the ſtomach. As it runs along the ſtomach it is ſenſibly exhauſted by theſe arteries, ſo that it arrives very ſmall at the lower or pyloric orifice of the ſtomach; there it turns over from the ſtomach upon the ſmall gut in ſuch a way as to belong to the pylorus or union of the gut with the ſtomach; and though ſmall and trivial, it has an appropriated name, ARTERIA PYLORICA SUPERIOR, and thus the gaſtric artery ends.

But ſometimes, as has been mentioned in the general deſcription, the gaſtric artery ſends a branch to the liver; yet, in that caſe, the order of theſe arteries already enumerated is in no degree diſturbed; the artery running along the œſophagus, the artery running round the cardia and in form of a crown, the artery returning along the leſſer arch, are ſtill the ſame; only, after giving off this laſt artery, the trunk of the gaſtric goes off from the ſtomach, continues its courſe towards the liver, and paſſes into it.

2. ARTERIA HEPATICA.

THE HEPATIC ARTERY goes off from the cœliac axis, where it almoſt touches the point of the ſpigelian lobe. The pancreas covers the root of the hepatic artery; it then turns a little forwards, and riſing ſomewhat upwards at the ſame time, it paſſes under the pylorus, *i. e.* under the ſtomach and duodenum; it paſſes behind the omentum minus and biliary ducts; it arrives at the porta where the great vena portæ enters the liver, and where the biliary ducts come out; it paſſes betwixt the biliary ducts and the vein; and having divided a little before into two great branches, theſe now enter into the right and left lobes of the liver. In this place it is incloſed along with all the other veſſels in that ſheath of cellular ſubſtance which is called the capſule of Gliſſon.

Thus the artery finally terminates near the liver in two great branches, right and left; but before it does ſo, it gives, as it paſſes the ſtomach, duodenum, pancreas, very important branches to theſe parts. Before it gives theſe more important branches, it gives ſmall twigs to the vena portæ and to the head of the pancreas; then it gives off the great artery which is the ſource of theſe leſſer arteries (to the pylorus, pancreas, and duodenum), viz. the ARTERIA DUODENO-GASTRICA, which, ſoon after it goes off from the hepatic artery, divides into two chief branches. One turns backwards along the duodenum to the ſtomach, and from ſupplying the ſtomach and epiploon, is named GASTRO-EPIPLOIC ARTERY. The other, turning downwards along the duodenum, gives at the ſame time arteries to the pancreas, and ſo is named ARTERIA PANCREATICO-DUODENALIS. The trunk which divides into theſe two arteries may be deſcribed thus: The duodenum begins from the pylorus; the pancreas pours its liquor into the duodenum; and therefore the head of the pancreas is attached to the duodenum: this marks the point at which the trunk of the ARTERIA DUODENO-GASTRICA goes off; for it riſes at right angles from the hepatic; it lies behind the lower end of the ſtomach juſt between the pylorus and pancreas; there it ſplits into its two great branches, viz. to the duodenum and to the ſtomach. But beſides theſe two great branches there are ſubordinate arteries, which muſt be enumerated together with them.

One artery goes off to the upper and back part of the duodenum over the biliary ducts; next go off ſmall arteries to the duodenum of ſtill leſs importance, and nameleſs; and at the ſame place ſmall twigs are often given to the pancreas.

The firſt which is diſtinguiſhed or regular, or has a name, is the PYLORICA INFERIOR, the lower pyloric artery. It goes off from the PANCREATICO-DUODENALIS almoſt as ſoon as it touches the duodenum; there are ſometimes two or more pyloric arteries going off at this point; they encircle the pylorus with delicate branches; and at the ſame time turn obliquely upwards, to receive inoſculations from the upper pyloric, which comes from the artery of the ſtomach.

The next artery to be diſtinguiſhed by a peculiar name is one which goes off directly oppoſite to this, belongs to the pancreas, and is named, from its running tranſverſely acroſs the pancreas, the TRANSVERSE PANCREATIC ARTERY. It is a neat ſmall branch, which paſſes under the pancreas, runs along its back part, gives its arteries into the ſubſtance of the pancreas from ſide to ſide; and yet is not exhauſted till it has run along more than two-thirds of the length of this long gland.

The next branch is that from which the whole artery has its name: for the artery having given off the lower pyloric artery, and the tranſverſe artery of the duodenum, turns downwards, bending according to the circle which the duodenum makes, lying in the hollow ſide of that circle juſt as other meſenteric arteries lie along their proper inteſtines. In all this circle it gives continual arteries outwards to the duodenum; it gives alſo frequent arteries inwards to the pancreas. From theſe two connections this branch is peculiarly named ARTERIA PANCREATICO-DUODENALIS. It ends in inoſculation with the meſenteric artery.

At the place where this pancreatico-duodenalis turns downwards, the other great branch turns backwards and upwards to reach the ſtomach. It is ſo great that it muſt be conſidered as the continuation and ultimate part of the artery. It goes to the ſtomach and epiploon, and thence is named gaſtro-epiploic artery.

The courſe of the gaſtro-epiploic artery is along the lower part of the ſtomach, and is moſt beautiful; it makes a broad ſweep round all the greater arch of the ſtomach; it lies in that line where the great omentum comes off from the ſtomach; it ſends many and large branches upwards upon the ſtomach, both on its fore and on its back ſurfaces; it ſends oppoſite branches, very frequent and conſiderable, down into the web of the omentum or epiploon; it runs along the ſtomach till it meets with a ſimilar branch from the ſplenic artery; and the inoſculation between them is ſo large and perfect, that we cannot tell where the one artery ends or the other begins. This branch from the hepatic artery is named the right artery of the ſtomach, or the right GATSRO-EPIPLOIC ARTERY, while that from the ſplenic artery is the left.

Beſides this great artery to the duodenum and ſtomach, the hepatic artery, before it plunges into the liver, gives another branch, but ſmall; it is named pylorica ſuperior hepatica.

PYLORICA SUPERIOR HEPATICA.

THE PYLORICA SUPERIOR HEPATICA is ſo named to diſtinguiſh it from that upper pyloric artery which comes down from the ſtomach, and ſometimes it is called GASTRICA vel CORONARIA MINOR. It comes off from the hepatic juſt before it divides, or immediately after from the left hepatic. It turns backwards at an acute angle to the leſſer arch of the ſtomach, and having given ſmall twigs to the omentum minus, it goes directly to the pylorus, inoſculating with its upper and lower arteries.

HEPATICA SINISTRA.

THE hepatic artery, now advanced to within about two inches of the liver, divides into its two great arteries. Both go to the porta of the liver; but the one belongs to the right lobe, the other belongs to the left. The artery which belongs to the left lobe of the liver is ſmaller, and when there is an hepatic artery from the ſtomach it is very ſmall; it mounts over the vena portæ, and enters into the liver at the foſſa umbilicalis; its branches within the liver go chiefly to the left lobe, lobulus ſpigelii, and anonymous lobe.

HEPATICA DEXTRA.

The right branch of the hepatic artery paſſes under the biliary ducts, enters along with them into the right lobe of the liver, and before it does ſo it gives off the arteria cyſtica, or artery of the gall-bladder, one of the moſt beautiful little arteries in the body. The cyſtic artery branches over the gall-bladder betwixt its coats, in the form of a coronary artery, and having made a beautiful tree of branches over the gall-bladder, it paſſes off from it, and goes to the ſubſtance of the liver.

ARTERIA SPLENICA.

The splenic artery is one of the moſt remarkable in the human body. The ſpleen is tied down to the left ſide of the diaphragm by a proper ligament; it is alſo connected with the greater or bulging end of the ſtomach by proceſſes of the omentum and by veſſels. The ſplenic artery, the largeſt branch of the cœliac, as large as a gooſe-quill, turns off from the cœliac trunk almoſt at right angles, and runs a foot in length acroſs the abdomen to get to the ſpleen. It is in all this courſe exceedingly tortuous; it runs along the upper edge of the pancreas (which alſo lies acroſs the abdomen), and gives arteries to it; when it approaches the ſpleen, it gives off that great artery which returns along the lower border of the ſtomach, and when it actually arrives at the ſpleen, it divides into a great many branches, which enter by the concave ſurface of the ſpleen, and plunge into its ſubſtance.

The branches then, of the ſplenic artery, are theſe: 1. It gives a great artery to the pancreas named PANCREATICA MAGNA, which paſſes to the right under the pancreas, and belongs chiefly to the head of the pancreas, or that rounded end which is next to the duodenum. Though named magna, it is a variable artery, and of little importance. 2. All along, as the ſplenic artery is paſſing to the left by the border of the pancreas, it ſends ſhort branches into it. They are named PANCREATICÆ PARVÆ, or ſmall PANCREATIC ARTERIES. 3. It often ſends ſmall arteries upwards to the back part of the ſtomach, named POSTERIOR GASTRIC ARTERIES. 4. The GASTRO-EPIPLOICA SINISTRA, or the left gaſtro-epiploic artery, is a very large and principal branch of the ſplenic artery. It ariſes under the ſtomach a little beyond the left or larger head of the pancreas; it makes a large arch, and then turns with a ſerpentine turn towards the ſtomach, returns along the lower border of the ſtomach within the doubling of the omentum, and gives its arteries upwards to the ſtomach and downwards upon the omentum, ſo much like thoſe of the right gaſtro-epiploic artery, that when they meet in the middle of the great arch of the ſtomach, and inoſculate, we cannot diſtinguiſh where either of them ends; the chief difference is, that ſome of the epiploic branches of this artery are particularly large. 5. The **VASA BREVIA** are a ſet of three or four arteries which the ſplenic gives off juſt before it enters into the ſpleen; and as the artery lies cloſe to the ſtomach, theſe arteries which go to the great bulging of the ſtomach are exceedingly ſhort, and are thence named vaſa brevia. The artery ends by eight or ten branches, which plunge into its ſubſtance. Sometimes we ſee the artery paſs, almoſt undivided, or divided into one or two branches only, into the boſom or ſinus of the ſpleen.

Theſe are all the arteries of the ſtomach, liver, and ſpleen, the viſcera which fill the upper region of the abdomen.

OF THE ARTERIES OF THE INTESTINES.

OF THE UPPER AND LOWER MESENTERIC ARTERIES.

THE bowels are ſo diſpoſed within the abdomen, that the largeſt of them, viz. the colon, the great inteſtine, encircles all the others. It begins on the right ſide in a blind ſac called the caput coli, or head of the colon: it goes upwards, and croſſes the belly, ſo as to ſupport the ſtomach, and ſeparate the ſtomach, liver, and ſpleen, from the ſmall inteſtines: it deſcends again into the pelvis at the left ſide, forming the rectum; and all the ſmall inteſtines hang by their meſentery in the central part of the abdomen, ſurrounded by this great inteſtine; and the arteries lie within the two lamellæ of the meſentery or ſupporting membrane of the inteſtines, ſo that they are called meſenteric arteries; and they follow the inteſtines in the order in which I have named them.

The GREAT OF SUPERIOR MESENTERIC ARTERY gives its firſt branches to the caput coli; its next branch to the middle of the colon under the ſtomach; the thouſand turns of the ſmall inteſtines next abſorb all its other branches. The LOWER MESENTERIC ARTERY, which gives no branches to the ſmall inteſtines, attaches itſelf to the left ſide, and eſpecially to the loweſt part of the colon, and goes down with the rectum into the pelvis, and ends there. This, then, may ſerve as a general plan or arrangement for the inteſtines and for the two meſenteric arteries.

I. MESENTERICA SUPERIOR.

It is not ſurpriſing that the UPPER MESENTERIC is the largeſt of all the abdominal arteries. It ariſes from the aorta, where it is ſtill betwixt the legs of the diaphragm, and not more than half an inch below the cœliac artery. The cœliac and meſenteric arteries lie cloſe upon each other; only we are leſs ſenſible of their nearneſs by the axis cœliacæ jutting perpendicularly forwards, and by the trunk of the meſenteric running very obliquely downwards, and by the head of the pancreas lying immediately over the meſenteric and hiding its root. The trunk of the meſenteric artery paſſes under the pancreas, then through the meſocolon or meſentery of the colon, then into the proper meſentery of the ſmall inteſtines. It turns firſt to the left; and then, by a ſecond gentle bending, it turns again towards the right ſide of the abdomen. It runs very low into the abdomen before it gives out any branches; and then it gives them off in the following order.

From the right ſide it gives branches to the great inteſtines, of which there are three chief arteries; but from the left ſide, where it gives arteries to the ſmall inteſtines, it gives innumerable branches, very large, and ſo inoſculated with each other, that they form a ſort of meſh or immenſe plexus in the meſentery before they go onwards to the guts. The undivided trunk of the artery is very large and long; the gentle curvature of it from left to right gives it the form of an Italic *ſ*; the prodigious ſize of that meſh or plexus of veſſels which goes to the great inteſtines is ſuch as to carry the artery down to the left ilium or flank where the caput coli or conjunction of the ilium with the colon lies.

It is from the convex of this gently bending arch, and from the right or outer ſide of the artery, that the following arteries to the great inteſtines go off[*]. The COLICA MEDIA to the middle of the great inteſtine, the COLICA DEXTRA to the right ſide of the great inteſtine, the ILEO-COLICA to the joining of the ilium with the caput coli or beginning of the great inteſtine.

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[*] Often before giving off its greater arteries, the meſenteric gives to the pancreas ſeveral ſmall arteries; and to the duodenum two or three, which are ſometimes named under the title of duodenales inferiores.

COLICA MEDIA.

1. THE MIDDLE COLIC ARTERY paſſes along in the doubling, *i. e.* betwixt the two lamellæ of the meſocolon. It goes with a circular ſweep upwards towards that part or corner (as we may call it) of the colon which lurks under the liver; but before it touches the inteſtine, and generally at the diſtance of about three or four inches from it, this artery divides into two great branches; one turning backwards, along the right ſide of the colon, inoſculates with the colic arteries; the other, more like the continued trunk, turns upwards, bending according to the curvature of the arch of the colon, which ſupports the ſtomach; and having rounded the concave of this arch, and arrived at the left ſide, it there makes a great inoſculation with the left colic artery, which is a chief branch of the lower meſenteric; and ſo completes the great meſenteric arch, one of the moſt celebrated inoſculations in the whole body, that of the circle of Willis hardly excepted.

COLICA DEXTRA.

2. THE RIGHT COLIC ARTERY is enumerated as a diſtinct artery, chiefly for the ſake of plainneſs; for though ſometimes it ariſes apart from the general meſenteric trunk, yet in ninety-nine of one hundred bodies it proceeds from the upper or middle colic artery. It is a very large branch; it is ſet off from the colica media at a very acute angle; it

moves along the right ſide of the colon, inclining alſo a little upwards towards the liver; it alſo ſplits when it approaches the gut into two branches; one turning towards the upper ſide to inoſculate with the middle colic artery, the other turning downwards towards the ilium or flank to inoſculate with the ileo-colic artery.

ARTERIA ILEO-COLICA.

3. THE ILEO-COLIC ARTERY ariſes about an inch lower than the laſt. It is a long, ſmall, and ſlender artery compared with the two laſt; which are ſhort, ſtumpy, and with contorted angles. This artery goes to the place where the ſmall inteſtines end, and the great ones begin; of courſe the membrane which holds the inteſtines at this corner (I mean in the right haunch) changes its name from MEZZO-COLON (in the middle of the colon) to meſentery, or MEZZO-ENTERON, (in the middle of the inteſtines); and of courſe the ileo-colic artery runs down, not along the meſocolon, but along the meſentery. It goes directly down towards the joining of the ilium with the colon; it ends in three regular branches; one paſſes ſtraight onwards to the junction of the ilium and colon, ſplits into two branches, one going over the fore and the other over the back part of the caput coli, and having a very curious correſpondence with the valve within, ſo that it might be called ARTERIA VALVULÆ COLI. While this branch goes ſtraight forwards over both ſides of the caput coli, another branch runs backwards along the colon, and inoſculates with the right colic artery; and another runs

downwards along the ilium, and inoſculates with the common branches of the meſenteric artery. It is from theſe two branches, which diverge like the reſt of the colic arteries, that this is called ILEO-COLICA. Even the appendix vermiformis has its little meſentery tying it down to the caput coli, and from the back of the caput coli a little artery runs down upon that meſentery to the appendix, paſſing along the whole length of that proceſs.

From this point all the remaining arteries of the meſenterica ſuperior go to the ſmall inteſtines; and they are ſo undiſtinguiſhed, and ſo prodigiouſly numerous, that no branches can be deſcribed or named; there is nothing but a great net-work of arteries to deſcribe. The firſt or radical branches which go to the ſmall inteſtines, are thick, large, ſhort, and vary from twelve to fifteen or twenty in number. But it is not theſe that make this vaſt appearance of a net-work; theſe twelve branches are firſt joined to each other, as it were mouth to mouth, forming one great confluence of arterial arches: from theſe, ſecondary branches ariſe, and they unite again in like manner, and make a ſecond row of arches; from the union of theſe ſtill other arteries ariſe, and make a third, or fourth, and even a fifth, row of arches, before any arteries go to the inteſtines; till at laſt the proper arteries of the inteſtines go out in ſtraight lines from the laſt arch, and ſpread upon the coats of the inteſtine. In ſhort, the meſentery has a very intricated and matted appearance; from the redoubling of theſe arches, which are more and more numerous as the artery proceeds lower, till the laſt of the twelve radical branches makes an arch, which ſerves the ilium or loweſt of the ſmall inteſtines, and inoſculates with the ILEO-COLIC ARTERY.

2. MESENTERICA INFERIOR.

THE LOWER MESENTERIC ARTERY is that which is named by Haller the left colic artery, becauſe it goes only to the left ſide of the colon. It ariſes from the forepart of the aorta, below the two emulgent arteries, *i. e.* pretty low down. It goes off rather from the left ſide of the aorta; it goes off very obliquely, and keeps cloſe to the left ſide of the aorta for a great way; and when it has deſcended as low as the bifurcation of the aorta, it gives off its great branch to the left ſide of the colon, viz. the LEFT COLIC ARTERY; and then turning down over the iliac artery of the left ſide, it deſcends into the pelvis, along with the rectum, and ends there.

1. Its firſt branch is the ARTERIA COLICA SINISTRA. The lower meſenteric has run a conſiderable length, has paſſed as low as the bifurcation of the aorta, before this branch is given off. This artery ſoon divides into three large branches; the trunk itſelf is ſhort and ſtumpy, the branches go off like thoſe of the other ſide, at very acute angles: Firſt, One branch aſcends towards the angle of the colon, under which the ſpleen lies, and there divides itſelf into two branches; one keeping cloſer to the inteſtine, nouriſhes it; the other keeping more to the middle of the meſocolon, or broad membrane of the colon, meets the branch of the upper meſenteric, and completes with it the meſenteric arch,

being indeed the larger and more important artery of the two. Secondly, Another branch goes directly acroſs to the right ſide of the colon, and when it approaches the gut ſplits (as uſual with the colic arteries) into two leſſer branches, one turning upwards and the other downwards. Thirdly, The third branch of this left colic artery goes obliquely downwards to that part of the gut which lies in the hollow of the left haunch-bone, and which forms the turn named ſigmoid flexure of the colon; and the membrane of the colon is here ſo faſt braced down to the loins that this artery gives twigs to the loins inoſculating with the lumbar arteries.

2. ARTERIÆ HÆMORRHOIDALES.

THE INTERNAL HÆMORRHOIDAL ARTERY is one of immenſe ſize; it is juſt the trunk of the lower meſenteric artery deſcending into the pelvis; it is often as large as a writing quill; it applies itſelf cloſely to the back part of the rectum; it arrives at it by turning in obliquely over the pelvis, and under the rectum, and paſſes down its whole length quite to the anus. It encircles the rectum completely on each ſide with is large branches, which meet again upon the forepart of the gut, and its branches lower down in the pelvis inoſculate with the middle hemorrhoidal artery, and ſometimes with thoſe of the bladder and womb. This is the artery which prevents us from operating when a fiſtula in ano has gone deep by the back of the rectum; and which has given occaſion to the eſtabliſhing of ſomething like a general rule in ſurgery, that one ſhould not operate when the fiſtulá is more than two or three inches deep. It is the laſt of the arteries belonging to the looſe and floating viſcera.

Of the ARTERIES of the FIXED VISCERA of the ABDOMEN.

THE fixed viſcera are, the capſulæ renales; the kidneys; the fat; and the teſticles, which in the child lie within the abdomen. Of the arteries belonging to theſe parts, thoſe of the kidney and teſticle are the only regular ones.

ARTERIÆ CAPSULARES.

THE capſulæ atrabiliariæ are two ſmall bodies of a triangular form, of thick walls and ſmall cavities, filled in general with a black and bilious-looking liquor. The ancients thought this the atrabilis, and named them the capſulæ atrabiliariæ: the moderns, from ſeeing them placed immediately above the kidney, and obſerving no apparent connection but with that gland, have named them capſulæ renales. They lie then above the kidney, are like the kidney ſurrounded with fat, have ſtraggling arteries from various ſources, but none regular nor important.

Firſt, They have very generally ſome ſmall branches from the phrenic arteries. Theſe are the higheſt of the capſular arteries; they touch the uppermoſt point of this glandular-like but unknown body. They are named the upper CAPSULAR ARTERIES. Secondly, They often have ſmall arteries from the aorta peculiar to themſelves, which come off about the root of the upper meſenteric artery, go to the fat and glands, and play over the vena cava (at leaſt thoſe of the right ſide do), and go to the middle parts of the gland, whence they are named CAPSULARES MEDIÆ. Thirdly, they have their laſt arteries ſent upwards to them from the emulgent artery, or artery of the kidney. They are named the lower CAPSULAR ARTERIES.

ARTERIÆ RENALES.

THE two RENAL or EMULGENT ARTERIES, the two arteries of the kidneys, go off from the ſides of the aorta, midway betwixt the upper and lower meſenteric arteries. Each goes to its kidney almoſt at a right angle, arching a little over the bulging belly of the pſoas muſcle. The aorta is ſtill a little inclined to the left ſide, and ſo the left emulgent is ſhorter, and mounts over its accompanying vein; while the right kidney, being further off from the aorta, and ſomewhat lower, on account of the liver being on that ſide, the right artery is longer, and is covered by its emulgent vein. When the emulgent artery, which is ſhort and very thick, arrives at the concave edge of the kidney, it is divided into three or four large branches, which ſurround the pelvis, or beginning of the ureter, plunge into the ſubſtance of the kidney, and inoſculate and make arches with each other. Then they, in ſupplying the kidney within its ſubſtance, form circles and arches over the roots of the papillæ uriniferæ, or ſecreting parts of the kidney, the veſſels being thus diſtinct from the glandular part; the vaſcular part, being outermoſt, is called cortical; the ſecreting, being innermoſt, is named the tubular part.

Before the emulgent arteries enter into the ſubſtance of the kidney to be thus diſtributed, they uſually give off ſmall arteries, as has been already mentioned, to the lower part of the capſula renalis, to the upper part of the ureter, and to the fat ſurrounding the kidney.

ARTERIA SPERMATICA.

THE SPERMATIC ARTERY, or artery of the teſticle, is one of the moſt ſingular, both for its extreme ſmallneſs and great length, and for its important office. It ariſes on each ſide from the lateral parts of the aorta, a little above the lower meſenteric artery. The left ſpermatic artery riſes ſomewhat higher, and often comes from the emulgent artery; it deſcends from the aorta almoſt in the ſame line with itſelf; it croſſes the vena cava, and meets its accompanying vein upon the ſurface of the pſoas muſcle; it then forms the ſpermatic chord, and paſſes out through the abdominal ring; before it goes down into the teſticle, it gives out many very ſmall twigs. Firſt, It gives ſmall twigs to the fat of the kidneys; ſecondly, It gives ſmall branches to the ureters; thirdly, Small twigs to the peritonem; and laſtly, Small twigs to nouriſh the ſpermatic cord itſelf. When it has paſſed through the ring, it ſoon after divides into many ſmall arteries for the ſeveral parts of the teſticle, four or five in number; two of which go to the epidydimis, and two others, particularly large, go to the teſticle; the largeſt of theſe branches turns round the teſticle in a beautiful and ſerpentine form, waving along the upper part of the teſticle, viz. juſt under the epidydimis, and ſending beautiful coronary branches downwards all over the ſemicircle or convex ſurface of the teſtis.

Theſe are the chief arteries, viz. thoſe of the kidney and teſticle. Thoſe of the renal capſule I hold to be ſo irregular, that they hardly deſerve the ſhort deſcription which I have given of them. The following claſſes of ſmall and irregular arteries are equally inſignificant; for few authors have been at the pains to enumerate the arteries going to the fat of the kidney; and none (except Murray) have been at the pains to gather together into one claſs or deſcription the trifling arteries of the ureter.

ARTERIÆ ADIPOSÆ.

THE ARTERIES of the FAT of the kidney are extremely ſmall but numerous. The upper arteries come from the capſular and diaphragmatic arteries which are above the kidney; the middle arteries of the fat come from the renal artery itſelf, from the ſpermatic, or even from the aorta; the lower arteries come from the colic arteries, and one from the ſpermatic, which comes off below the kidney, and turns up towards its lower end.

ARTERIÆ URETERICÆ.

THE ARTERIES of the URETER, as it is a long canal, come off from various parts which it paſſes. Its upper arteries are from the renal artery itſelf, before it enters the kidney; and alſo from the capſulars and ſpermatics. The middle arteries of the ureter are more particular and more important: they ariſe either from the aorta itſelf, or from the iliac artery, where the ureter croſſes it; and they run far, both upwards and downwards, along the canal. The loweſt arteries of the ureter ariſe from thoſe of the bladder itſelf.

ARTERIÆ LUMBARES.

THE LUMBAR ARTERIES are thoſe which ſucceed to the intercoſtal arteries, and which run parallel with them; performing the ſame office in the loins which the intercoſtals do in the thorax, viz. nouriſhing the ſpine and the muſcles.

The lumbar arteries ariſe from the ſides of the abdominal aorta. The firſt arteries go off at right angles; the lower ones are a little inclined downwards. The right ones are longer, becauſe they have to riſe over the ſpine. The arteries of both ſides, as ſoon as they have left the ſpine, ſink under the pſoas muſcle, and go onwards behind it, round the ſide, till they terminate in the lateral muſcles of the abdomen. The uppermoſt lumbar artery is large; and as it runs along the loweſt rib but one, it of courſe gives arteries both to the tranſverſe or innermoſt muſcle of the belly, and alſo to the diaphragm, which indigitates with it in conſequence of their both taking their origin from the ſame ribs. The two lower lumbar arteries are ſmall, and begin to inoſculate with the leſſer arteries about the top of the pelvis.

Each lumbar artery gives out like each intercoſtal two chief arteries: 1. One which goes to the ſpine, and which, ſplitting into two, gives a larger twig to the vertebra itſelf; and a ſmaller one, which enters the ſheath, traces the nerve backwards, and paſſes into the ſpinal marrow. 2. A muſcular branch, which is alſo divided; for one branch of it ſupplies the pſoas muſcle, and then runs round within the muſcles of the abdomen; while the other pierces the back, and ſupplies the ſacro-lumbalis, longiſſimus dorſi, and other muſcles of the loins.

ARTERIES OF THE PELVIS.

The aorta divides into two great arteries, named iliac from their beginning in the loins. The two iliac arteries move downwards to the brim of the pelvis, where they meet the veins of the lower extremity aſcending to form the cava, and alſo a vaſt plexus of lymphatics from the legs and pelvis, which twiſt round the arteries and veins. The two iliac veins lie upon the inner ſides of the two arteries; and ſince theſe veins meet on the right ſide of the aorta to form the cava, of courſe the right iliac croſſes the trunk of the cava. This bifurcation of the aorta is much higher than the pelvis; it begins upon the fourth vertebra of the loins, ſo that the abdominal aorta is in truth extremely ſhort, and the iliac arteries go off at ſuch an angle, that they diverge very gradually; ſo that when they arrive at the top of the pelvis, they are juſt over the joining of the haunch-bone with the ſacrum: and it is but a very little below this again that they divide into their two great branches; the one, named the external iliac, which paſſes ſtraight forwards into the thigh; the other, the internal iliac, which dives immediately down into the pelvis to ſupply the internal parts; and this is the artery which muſt be firſt deſcribed.

ARTERIA SACRA MEDIA.

THIS bifurcation of the aorta gives off juſt one artery, which proceeds exactly from the fork; and being in the middle, it is a ſingle or azygous artery, which has not a fellow. It is ſmall, long, very regular, and paſſes down ſo correctly in the middle of the bone, that it is named the MIDDLE SACRAL ARTERY. It is about the ſize of a crow-quill; paſſes directly over the middle of that projecting point which is named the promontory of the ſacrum; it deſcends expreſsly in the middle of the bone, quite to the point of the os coccygis. At the place of each vertebra (for the ſacrum conſiſts of vertebræ now united together), it gives off croſs branches, which go acroſs the body of the ſacrum to inoſculate with the lateral ſacral arteries. Beſides theſe, it gives arteries to the ſubſtance of the bone, and not unfrequently ſmall arteries to the rectum. This artery ends near the point of the os coccygis in a forked or double inoſculation with the lateral ſacral arteries of each ſide.

ILIACA INTERNA.

THE INTERNAL ILIAC ARTERY is of vaſt ſize; it not only ſupplies all the parts within the pelvis, but ſends out by the ſeveral openings of the pelvis thoſe great arteries which ſupply both the private parts, and the immenſe maſs of muſcle which ſurrounds the haunch. Thence the neceſſity and the uſefulneſs of arranging them under two claſſes: Firſt, Of the leſſer arteries which go to parts within the pelvis, as to the loins, to the ſacrum, to the bladder, and to the womb; and ſecondly, Thoſe infinitely larger arteries which go out through the ſeveral openings of the pelvis, and go to the hips, the haunch, and the private parts.

This artery we cannot deſcribe in the adult, without attending to its condition and function in the child; for it is that indeed which gives it the peculiar form which we have to deſcribe; and which eſpecially gives it that arch downwards, from the convexity of which all the great branches go off. For in the child, the internal iliac or hypogaſtric artery is extremely large: Firſt it turns down into the pelvis with a large circle; then it goes cloſe to the ſide of the bladder very low into the pelvis; then it begins to riſe again by the ſide of the bladder, out of the pelvis, and going along by the urachus (which is a tube or ligament rather leading upwards from the bottom of the bladder), it goes out by the navel, forming the umbilical artery. Now this ſudden turn by the ſide of the bladder makes the artery convex downwards, i. e. towards the parts which it has to ſupply. The artery keeps this ſame form in the adult; both in the child and in the adult all the great branches come off from the back of this arch.

ORDER FIRST.

The branches of the hypogaſtric or internal iliac artery, which remain within the pelvis.

1. ILEO-LUMBALIS.

THIS artery is ſo named, becauſe it ſo reſembles the lumbar arteries that it might be miſtaken for the laſt of them; and becauſe it belongs equally to the haunch-bone and to the loins. It goes off from the outer ſide of the iliac artery, about an inch below the bifurcation; it is about the ſize of the lumbar arteries, or a little larger; it turns in behind the iliac artery, and paſſes under the pſoas muſcle; its trunk is ſhort, for it ſplits immediately into its iliac and lumbar branches. The lumbar branch goes off betwixt the laſt vertebra of the loins and the inner end of the ilium, and goes directly upwards; it gives its branches about the pſoas muſcle. The iliac branch ſetting off from the ſame point, runs ſtraight outwards, lodges itſelf under the edge or criſta ilii, and ſupplies the iliacus internus muſcle by a ſuperficial branch; and it nouriſhes the bone by a deeper branch, which lies cloſe in the hollow of the haunch.

2. ARTERIÆ SACRÆ LATERALES.

THE LATERAL ARTERIES of the SACRUM are very generally three or four in number. Sometimes we find one general artery coming off from the iliac, or from the ileo-lumbar artery, running down all the ſide of the ſacrum, and giving off the lateral ſacral arteries; but much more frequently we find three diſtinct arteries coming off from the ſides of the iliac artery, which run acroſs the ſacrum in the following manner, to inoſculate with the middle ſacral artery: Firſt, Each lateral ſacral artery has one large branch, which runs along the forepart of the ſacrum, runs along the naked bone, and inoſculates with the middle ſacral artery: Secondly, Another branch, ſtill larger, dives into each of the ſacral holes, which not only nouriſhes the nerves, and the ſheath of the cauda equina, and the bone itſelf by one branch, but penetrates by another branch through the poſterior ſacral hole, and ſupplies the perioſteum, the great ligaments which join the ilium to the ſacrum, and the root alſo of the ſacro-lumbalis, and glutæal muſcles. From theſe two branches (viz. to the ſpine and to the poſterior muſcles), and from the regularity of theſe five arteries (going from ſome artery or other into each ſacral hole), they may be reſembled to the intercoſtal and lumbar arteries, to whoſe office and plan they have ſucceeded.

ARTERIA HYPOGASTRICA.

THE HYPOGASTRIC ARTERY is the umbilical artery, of great ſize and importance in the child; and even in the adult it ſtill remains, in this ſenſe at leaſt, that though the forepart of it (where it turns up by the ſide of the bladder) is cloſed, even that part is ſtill known by a round ligamentous ſubſtance, into which it is converted, which we eaſily trace up to the navel, where the artery meets its fellow of the other ſide.

This artery is even in the adult body pervious down to the ſide of the bladder, where in Man it gives one long and ſlender artery, ſometimes two, which go to the ſides of the bladder; and in Women, ſmall arteries to the womb, ſometimes to the rectum; but theſe branches are quite irregular in number and ſize.

ARTERIÆ VESICALES.

THE ARTERIES of the BLADDER are extremely irregular both in number and ſize; for it is to be conſidered, that the bladder being a round body placed amidſt great arteries, and being itſelf membranous, and needing but few or but ſmall branches, it gets them from various ſources. Very generally the hypogaſtric, juſt before it cloſes into a ligament, ſends one or more ſmall arteries downwards and forwards to the neck of the bladder, at that part where the veſiculæ ſeminales lie; and of courſe the veſiculæ and the proſtate gland get ſmall twigs from this artery of the bladder; ſometimes alſo the bulb of the urethra has a ſmall artery from it.

ARTERIÆ HÆMORRHOIDALES.

THE arteries of the rectum are all named hæmorrhoidal arteries. The upper hæmorrhoidal artery is the great branch of the lower meſenteric continued to the pelvis. The middle hæmorrhoidal artery is one which ſometimes comes from the hypogaſtric artery, but very often from the pudic artery, inſomuch as to be reckoned among its regular branches. The lower, or the external hæmorrhoidal artery, almoſt always is a branch of the pudic artery, or that artery which goes to the penis. Two great arteries, one going to the rectum and another to the womb, are the laſt which the hypogaſtric gives off before it degenerates into a ligament.

ARTERIA HÆMORRHOIDEA MEDIA.

THE middle hæmorrhoidal artery is not a large branch. Often we do not find it, but other arteries ſupplying its place; ſometimes again it is ſo large as to give off both the uterine and the lateral ſacral arteries; but in general it is ſmall. It comes off from the hypogaſtric oppoſite to the glutæal artery (preſently to be deſcribed); it touches the rectum below its middle, and deſcends curling and winding chiefly along its forepart quite to the anus; and often it gives, as it runs betwixt the rectum and bladder, arteries to the bladder, proſtate gland, and veſiculæ ſeminales. It is this artery alſo which in Women gives ſmall branches to the vagina.

ARTERIA UTERINA.

THE womb has four arteries, two from each ſide; the uppermoſt that which enters by the upper corners of the womb, comes from the aorta, correſponds with the ſpermatic in Man, runs along the broad ligament towards the ovaria. The lower artery of the womb, and the largeſt, comes from the hypogaſtric, enters the womb, where it is connected with the vagina, and runs upwards along the ſides of the womb to meet the ſpermatic; and it ſends alſo at the ſame time branches downwards into the vagina, and forwards upon the bladder, where it adheres to this part of the womb.

This uterine artery ariſes from the hypogaſtric beſide the origin of the hæmorrhoidal artery, and when it enters the womb it becomes very tortuous.

Theſe, then, are the chief arteries of the rectum, bladder, womb, veſiculæ ſeminales, and other parts within the pelvis.

ORDER SECOND,

OF THE ARTERIES WHICH GO OUT FROM THE PELVIS TO THE HAUNCHES, HIPS, AND PRIVATE PARTS.

In this ſecond claſs or order there are juſt four great arteries; one which goes over the back of the haunch-bone to the glutæal muſcle, named Glutæal artery; one going downwards over the tuber iſchii to the hip, named the Iſchiadic artery; one which goes out of the pelvis, returns into it again, and paſſes out a ſecond time by the root of the penis, named the Pudic artery; and one which paſſes out through the thyroid hole into the deep muſcles at the top of the thigh, named Thyroid artery. All theſe larger arteries go off from the convex of that arch which the hypogaſtric forms, and move backwards and downwards, in order to eſcape from the pelvis, either by the ſciatic notch or below.

Let it be remembered, that the iliac artery forks juſt at the meeting of the ilium and ſacrum; that the great ſacro-ſciatic notch is formed by this joining of the ilium and ſacrum, and is juſt under the junction of theſe two bones: that the glutæal artery paſſes out by this ſacro-ſciatic hole; and that of courſe it is the firſt, as well as the greateſt, of thoſe three arteries which turn backwards out of the pelvis.

ARTERIA GLUTÆA.

THE GLUTÆAL ARTERY goes off from the internal iliac immediately after the lateral ſacral arteries. It is exceedingly large, thick, and ſhort, within the pelvis, for it immediately turns over the bone; the turn which it makes over the naked bone is backwards and upwards; it inſtantly divides itſelf into a great laſh of veſſels, which ſpread in every direction, ſupply the two glutæal muſcles, and turn and ramify upon the back of the haunch-bone, juſt as the great ſcapular arteries play over the ſurface of the ſcapula.

The pyriform muſcle goes out from the pelvis at the ſame great opening with the glutæal artery, and the artery is further accompanied by the great ſciatic nerve; they paſs together over the pyriform muſcle betwixt it and the bone; and when the glutæal artery is to give out its branches, it ſplits into two great branches at the edge of the glutæus medius muſcle. By this ſplitting the gluteal artery is arranged thus: Firſt, One great branch paſſes under the glutæus medius, of conſequence it is naked upon the back of the ilium; it ſends one large and beautiful artery, which courſes round the bone according to the line of the criſta ilii, which ſupplies all the upper half of the haunch-bone with its nutritious arteries, and ſupplies of courſe all the upper half of the great or outermoſt glutæal muſcle where it ariſes from the ſpine and dorſum of the ilium. Another large branch, ſtill belonging to this deeper artery, paſſes under the thickeſt part of the belly of the glutæus medius, lies upon the ſmall fan-like muſcle named glutæus minimus, and gives innumerable great branches to the middle and leſſer glutæi muſcles, and to the joint of the thigh-bone.

The other great branch of the glutæal artery ſlips in betwixt the glutæus major and the glutæus medius; and as it lies betwixt theſe two great muſcles, it gives a prodigious number of branches to each, but chiefly to the great glutæal muſcle.

ARTERIA ISCHIADICA.

THE SCIATIC ARTERY is ſo named, becauſe, inſtead of going upwards with this crooked turn towards the haunch, it goes obliquely downwards to the hip, in the direction of the main artery from which it comes. It comes off from the iliac about an inch lower than the glutæal, and is next to it in ſize; almoſt equal when (as it often happens) the pudic artery is derived from it. The glutæal artery ſhould be contraſted with it thus: The glutæal goes out above the pyriform muſcle; the ſciatic goes out below it; the glutæal turns upwards over the haunch-bone, the ſciatic turns downwards along the hip; the glutæal ſpreads its arteries wide with ſudden and crooked angles; the ſciatic ſends its arteries downwards in a gentle waving form, or almoſt ſtraight; and ſo numerous as to be compared with a laſh of many thongs proceeding from one ſhaft.

Often the glutæal artery, before it paſſes out of the pelvis, gives ſmall twigs to the rectum, to the bone, and to the pyriform muſcle; and in like manner the iſchiadic, before it eſcapes from the pelvis, gives alſo trivial branches to the rectum, and to the pyramidal muſcle.

The branches of ſo great an artery, ramifying merely among muſcles, and among ſuch a vaſt variety of muſcles, can neither be named, nor are worth naming. All that is to be deſired is, to know the trunk, and the general direction in which its greater branches go. Among theſe branches there are few remarkable.

Firſt, The COCCYGEAL ARTERY turns quick backwards upon the ſciatic ligaments, and lying under the glutæus magnus; and paſſing along by the direction of the ligament, it ariſes at that part of the ſacrum whence the ligament takes its riſe; and turning downwards upon the coccyx, and upwards upon the back of the ſacrum, it inoſculates with the ſacral arteries through the poſterior holes.—Secondly, Another branch, more remarkable for its office than its ſize, runs downwards along the ſciatic nerve, ſupplying its coats and ſubſtance.—But the great branch of this artery ſends a confuſed laſh of arteries downwards, which give arteries, firſt to the glutæal muſcles and pyriformis, and then downwards to all thoſe muſcles of the back of the thigh which ariſe about the knob or tuber of the iſchium. In ſhort, all its chief branches are muſcular; and the artery is remarkable for no other peculiarity than this, that its inoſculations downwards with the reflected arteries of the thigh are ſo frequent, that theſe alone may ſave the limb in wounds of the femoral artery above its profunda, or that great branch which belongs to the thigh.

ARTERIA PUDICA COMMUNIS.

The common pudic artery *, or the artery of the external parts of generation, is the third great artery which goes out from the pelvis backwards. And there is in the courſe of this artery a peculiarity which is never fully explained; and being unexplained, makes the ſucceeding deſcription quite defective and lame: and it is this. The pudic artery (which is nearly of the ſize of a writing quill) uſually comes off as a branch from the ſciatic artery; it goes out from the pelvis along with the ſciatic artery through the lower part of the ſciatic notch, under the lower edge of the pyriform muſcle, over the upper ſacro-ſciatic ligament. But no ſooner has it made its appearance along with the ſciatic artery, and emerged from the pelvis, than it returns into the pelvis again; it does not go over the outſide of the tuber iſchii, and ſo down to the perinæum; but it juſt appears out of the pelvis, riſes over the upper ſacro-ſciatic ligament, gives out a few branches, turns in again under the lower ſacro-ſciatic ligament, or rather under the ſpine or ſharp point of the iſchium, whence that ligament ariſes: it is now within the pelvis again; it lies flat againſt the inner ſurface of the iſchium; it runs along by the direction of that bone till it approaches the ſymphyſis pubis, where the root of the penis is. It there dives into the root of the penis, having juſt

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* It is named often the circumflex pudic artery, the internal pudic artery, the middle pudic artery, the great pudic artery.

before given off that branch which goes to the perinæum. It is this long artery, running naked and unprotected along the whole inner ſide of the iſchium, bending as the arch of the iſchium and pubis bends, that is cut by ignorant lithotomiſts, which a broad gorget is ſure to wound, and which can be ſafe only by our exchanging the gorget for the knife.

The branches of the pudic artery are chiefly theſe: —Firſt, Before it proceeds out of the pelvis, it uſually ſends branches inwards to the neck of the bladder, veſiculæ ſeminales, and proſtate gland:—Secondly, When it emerges from the pelvis, and while bending over the ſacro-ſciatic ligament, it gives, like the ſciatic artery, chiefly muſcular branches; it gives twigs to the ſacro-ſciatic ligament and pyriform muſcle; others go to the gemini muſcles, and turn over them to the great trochanter, and to the hip-joint, reaching as far as the acetabulum; others ſpread over the tuber iſchii, to which they give arteries, which go outwards along the three muſcles of the thigh which ariſe from this point; and it ſends inwards from this part an artery which encircles the verge of the anus, and belongs to the ſphincter and levator ani muſcles. This branch is named the LOWER OF EXTERNAL HÆMORRHOIDAL ARTERY: and other branches it ſends forwards into the perinæum; but theſe are ſmaller and leſs regular arteries; they are not what are diſtinguiſhed by the peculiar name of perinæal arteries. This artery, like the iſchiadic, ends every where in inoſculations with the reflected arteries of the thigh.

Thirdly, The artery returning again into the pelvis, and running along under the flat internal ſurface of the iſchium, gives off many ſmall branches to the bladder, proſtate gland, veſiculæ ſeminales, and rectum. But when it has reached the perinæum, and is about to emerge from the pelvis a ſecond time, and go into the root of the penis, it gives out three chief arteries; one to the perinæum, one to the body of the penis, one to the back of the penis thus:

When the artery has approached nearly to the muſculus tranſverſalis perinæi, it ſplits into two branches; one of which is the artery of the perinæum, the other is the proper artery of the penis.

ARTERIA PERINÆI.

THE ARTERY of the PERINÆUM paſſes under the tranſverſalis perinæi, and betwixt the accelerator and erector penis; in ſhort, it comes out from that triangular cavity which we cut into in lithotomy; in which operation of courſe this branch cannot eſcape. The artery having eſcaped from this triangular cavity, runs forwards along the perinæum for two or three inches, according to the ſize of the ſubject, growing very ſenſibly ſmaller as it goes along. It is chiefly for ſupplying the ſkin and muſcles of the perinæum; and gives theſe branches: 1. When it has juſt come out from the triangular hollow, it gives off from its root one branch at right angles, which goes directly acroſs the perinæum; it keeps the courſe of the tranſverſe muſcle; it may be named ARTERIA TRANSVERSALIS PERINÆI, and ends about the ſphincter ani. 2. It gives branches to the accelerator and erector muſcles. 3. It gives branches to the ſcrotum; and being continued along the corpus cavernoſum of each ſide, it ends upon the tendinous ſheath, which binds the corpora cavernoſa. Thus ends the perinæal artery.

ARTERIA PENIS.

THE PROPER ARTERY of the PENIS is the continued trunk of the pudic artery. It is much larger than this perinæal branch; is as big as a crow-quill; it keeps ſtill cloſe to the bone, while the perinæal artery goes outwards; it at laſt touches the ſymphyſis pubis, and of courſe pierces the corpus cavernoſum, juſt where it takes its riſe from the leg of the pubis: and here it ſplits into two great branches; one to the corpus cavernoſum, and one to the back of the penis, or rather into three, ſince there is one alſo for the bulb of the urethra.

The bulb of the urethra is quite inſulated in the perinæum, while the corpora cavernoſa ariſe from the bone. Now, firſt, as the artery of the penis is paſſing by the ſide of the bulb, it gives off an artery to the bulb ſidewiſe, which in part plunges into the bulbous ſubſtance, and in part is ſcattered upon the accelerator, proſtate gland, &c.

Secondly, The artery having riſen to the place where the root of the corpus cavernoſum is, gives off that artery, which runs ſmall and delicate along all the back of the penis, till it ends at laſt in a branch which encircles the corona glandis. This is named the arteria dorſalis penis.

Thirdly, The artery now plunges deep into the proper ſubſtance of the penis; the artery of each ſide goes into each corpus cavernoſum at its root, and ſplits into two branches; theſe run chiefly along the ſeptum, or partition betwixt the corpora cavernoſa of each ſide.

It is this artery which pours out blood ſo freely into the cells of the penis, and cauſes erection.

Theſe three, the glutæal, the ſciatic, and the pudic arteries, are the only ones which go out from the pelvis behind, and one only goes out by an opening on its forepart, viz. the obturator artery.

ARTERIA OBTURATORIA.

THE OBTURATOR ARTERY is ſo named from its paſſing through the thyroid hole. No artery is leſs regular in its origin; ariſing ſometimes from the Iliac, ſometimes from the Hypogaſtric, and not unfrequently from the root of the Epigaſtric artery: in which caſe it turns back again over the pubis, coming into the pelvis through the ring. But no artery is more regular in its deſtination; a large artery always paſſes through the thyroid hole; the thick muſcles in the centre of the thigh cannot want it.

The obturator artery, ariſing from the iliac or hypogaſtric, runs along by the upper edge of the pelvis, by the lower edge of the pſoas muſcle, accompanied with the obturator nerve, which is to go through the hole along with it. Having arrived at the forepart of the pelvis, it ſlips through the oval hole by a very ſmall opening, which is in the upper part of the tendinous membrane, which cloſes that hole, and which is conſequently at the upper edge of the obturator internus muſcle. The artery, before it paſſes out of the pelvis, often gives branches of conſiderable ſize downwards to the neck of the bladder, proſtate gland, and veſiculæ; to the iliacus internus and pſoas muſcles, and to the lymphatic glands which lie upon them;

and there is always a branch, which encircles the upper part of the foramen thyroideum, lies cloſe upon the bone, and gives its twigs upwards into the muſcles of the belly.

After the artery has paſſed along with its nerve through the thyroid hole, it comes into the very heart or central part of the thigh. Almoſt all its branches are muſcular; none are worth diſtinguiſhing by name; it is only the general tendency of the artery that needs to be explained. It divides into two chief branches, taking oppoſite directions. The firſt is deeper; it turns downwards and outwards towards the hip-joint. It performs three ſervices here; it gives firſt arteries to the perioſteum, to the capſule, and to the gland within the acetabulum; it gives alſo large branches to the obturator quadratus femoris, and all the great muſcles which immediately ſurround the joint; it alſo forms very large and important anaſtomoſes round the joint, with the ſciatic and pudic arteries from the pelvis, and with the reflected arteries from the thigh.

The more ſuperficial branch of the thyroid ſends all its branches into the great muſcles upon the inner ſide of the thigh coming from the pubis. Its chief branches are to the upper part of the triceps muſcle; it ſometimes gives branches even to the ſuperficial muſcles, as the gracilis and ſartorius; always, at leaſt, ſmall twigs paſs through theſe muſcles to the ſkin of the thigh and to the ſcrotum. Of theſe two arteries, this ſuperficial one encircles the inner edge of the thyroid hole, or that which is next the pubis, with one of its branches; while the deeper artery encircles the outer edge, or that which is next to the hip-joint; ſo that they meet upon the bone inoſculating with each other.

CHAP. IV.

ARTERIES OF THE LOWER EXTREMITY.

ILIACA EXTERNA.

THE EXTERNAL ILIAC ARTERY is that branch of the common iliac which deſcends under Poupart's ligament into the thigh. The internal iliac or artery of the pelvis parts from this within the pelvis at the joining of the ilium and ſacrum. The external iliac paſſes down into the thigh, by bending along the upper edge or brim of the pelvis, directed by the lower edge of the pſoas muſcle, which alſo deſcends into the thigh. This great artery is accompanied by the anterior crural nerve; its correſponding vein lies by the ſide of it; the lymphatics of the thigh creep upwards along this artery into the pelvis; and when the artery deſcends into the thigh, it paſſes ſo over the bulging part of the acetabulum and head of the thigh-bone, that it is felt projecting there and beating with amazing force.

The projection by which the artery is thus thrown forwards is not merely the naked pelvis and the head of the femur; theſe parts are covered by the fleſh and tendons of the pſoas magnus and iliacus internus, which alſo come out from the pelvis to the thigh. The artery lies cuſhioned upon theſe muſcles; the muſcles dive very deep to get at the trochanter minor or poſterior trochanter of the thigh-bone. The artery follows them; and thus it is plunged as it were into a deep cavity, aſſumes a new poſition, and this conſtitutes a ſecond point of deſcription.

The hollow in which the artery now lies may be compared with that of the bend of the arm. The artery now takes the name of femoral, lies deep in a hollow ſurrounded by much fat and many glands; the cavity is covered with a very ſtrong faſcia, or tendinous ſheath, which deſcends from the muſcles of the belly over Poupart's ligament, and which is greatly ſtrengthened at this point by the general faſcia of the thigh. Here the femoral artery, inſtead of ſending off leſs effectual branches from point to point as it moves downwards, and which could not have conveniently penetrated through all the thickneſs of the thigh, ſends off one great branch, which furniſhes all the thigh without exception, whence it is named the muſcular artery of the thigh. This great artery goes off from the femoral juſt like the ulnar from the artery at the bend of the arm, *i. e.* very deep among the muſcles, in the triangular cavity above deſcribed. Thence it is oftener named profunda than muſcular artery.

The femoral artery having ſent down this great branch, equal almoſt to itſelf in ſize, inclines outwards again, meets the inclined line of the ſartorius, and follows its oblique direction, aſſuming a new character; for now it becomes a ſecond time quite ſuperficial, is covered by nothing beſides the ſtrong faſcia of the thigh and by the ſkin. It is felt beating along the line of the ſartorius muſcle; and by that line we apply the cuſhion of our tourniquet. It retires from our feeling only about two hands breadth, or a little more, above the joint of the knee; at which place it perforates the triceps or great muſcle of the thigh, gets from the fore to the back part, or, in other words, forſakes the thigh to go down behind into the ham, where it exchanges its name for that of popliteal artery.

The popliteal artery, when it has got into the ham, meets with its correſponding nerve, which is of vaſt ſize; and the artery lies now flat upon the back part of the thigh-bone, paſſes down in a hollow formed betwixt its great condyles, lies flat upon all the back of the knee-joint, is encloſed by the two great hamſtring muſcles from above, and by the two great heads of the gaſtrocnemii muſcles below. But although we ſay it is protected, yet in truth it is not tightly bound down by a faſcia embracing it, but lies on the contrary ſo looſe and unſupported among the cellular ſubſtance, that we have the moſt certain evidence of its being often racked and ſtrained in ſudden or awkward motions of the joint.

From the ham the artery deſcends into the leg, under the heads of the gaſtrocnemii muſcles; and being lodged behind the great bulging, or head of the tibia, below the joint, it there divides into three great arteries.

ries. One paſſing down behind the tibia is named poſterior tibial artery; one perforating the interoſſeous membrane goes down along the forepart of the tibia, is named tibialis antica; the third artery, paſſing down behind the fibula, is named the fibular or peronæal artery. Theſe may be juſtly compared with the three arteries of the forearm; and as thoſe meet in arches upon the palm of the hand, theſe meet and form ſimilar arches on the ſole of the foot.

Even from this ſlight and general deſcription of this important artery, many concluſions may be deduced not indifferent to the ſurgeon; for there are ſeveral points in the courſe of this artery very peculiarly marked.

Firſt, It is thrown ſo forwards by the bulging of the pubis, where it forms the ſocket for the thigh-bone, it beats ſo ſtrongly juſt under the rim of the belly, that we cannot, at leaſt till we try, doubt of its being eaſily compreſſed. I ſee, indeed, that Acrel, in very deſperate circumſtances, when his ligatures had given way even before his eyes, and the arteries burſt, and after the ſurgeons had been twice deluged with the blood of the femoral artery, thought that he had ſuppreſſed this artery, by reſting on it with his thumbs. But indeed the poor patient, under theſe horrible circumſtances, as Acrel juſtly calls them, muſt have fallen ſo faint and low, by a tedious alarming operation, and by the repeated bleedings, that any thing might have ſuppreſſed the pulſe in the femoral artery, when that of the heart itſelf was well nigh gone.

gone *. But this is one of the points in which it is the moſt neceſſary for every man to ſpeak from his own experience. I have tried it in the moſt favourable circumſtances in a ſlender young man; and when I thought myſelf ſure of the point, behold the blood guſhed out with a whizzing noiſe and prodigious force. I have ſeen others try it, and fail. It is perhaps not impoſſible to compreſs the femoral artery; but it is not an eaſy thing, and is an expedient never to be truſted where the life of a fellow-creature is immediately in danger.—Secondly, This ſtrong covering of the faſcia gives a peculiar form to the aneuriſm of the thigh; it keeps it flat, forces the blood to ſpread abroad into the ſurrounding parts; and this deep driving of the blood among the muſcles, together with the great ſize of the ſac, and the putrefaction of three or four pounds of blood, cauſes that gangrenous and ſloughing condition of the parts, by which we are ſo often foiled in our beſt concerted operations, and after the artery has been well and fairly tied.—Thirdly, It is very obvious that the profunda might with more propriety be named the femoral artery, ſince it is the proper artery of the thigh; and though Heiſter, and ſome of the beſt among the old ſurgeons, ſpoke of this diviſion as one which only ſometimes took place, we know that a leg could no more be without a profunda than without what we call the femoral artery; and

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* "His in horrendis anguſtiis, cum nec nova ligatura, nec torcularis contractione hæmorrhagia ſiſti poſſet, in trunco ipſo, dum ex inguine prolabitur, pollicibus firmiter admotis, compreſſionem inſtituere placuit, quo effluxus ſubſtitit."

we alſo perceive, notwithſtanding the doubts and fears of ſome modern ſurgeons, that when the femoral artery is wounded, it is after all only a wound of the artery of the leg.——Fourthly, The large branches which the profunda ſends upwards round the haunch, inoſculating with the ſciatic and pudic arteries, and the branches which it ſends downwards to the knee, inoſculating round that joint with the arteries of the leg, make this branch of peculiar importance to the ſurgeon; for when the artery is wounded in the groin, above the profunda, this branch ſaves the thigh, by its inoſculations round the haunch; and when the artery is wounded in the thigh, below the profunda, or in the ham, it ſaves the leg by its inoſculations round the knee; and when the whole line of the femoral artery has been obliterated, it has ſaved the whole extremity, as I have elſewhere proved, by receiving the blood from the arteries round the haunch, and conveying it down to the arteries below the knee, being thus an intermedium betwixt the internal iliac artery and the arteries of the leg, capable of forming a new line of circulation behind the thigh when that before is ſhut up. Nor ſhould it be forgotten, that the aneuriſm on the forepart of the thigh may be from the profunda; and then the femoral artery which lies before it may be cut acroſs by a raſh or ignorant ſurgeon.

Fifthly, The place of the femoral artery paſſing through the triceps muſcle is next to be obſerved, for theſe reaſons. At that point it lies cloſe upon the bone; and as this happens exactly at that diſtance above the knee at which we uſually amputate, we expect in ſuch amputations to find the great artery cloſe by the bone. As the artery is at this point tied down by the tendon of the triceps, and is in fact paſſing through a tendinous ring, it ſometimes happens that when we have cut near this, but not upon it, the fleſh ſhrinks in ſuch a way that even this great artery, though it bleeds, is not eaſily found; but one ſtroke of the ſcalpel, running along the bone, cuts the tendon up, and expoſes the artery with open mouth.——This ſingle point makes all the difference betwixt an aneuriſm of the thigh and of the ham; it is peculiarly neceſſary to mark this, in order to aſcertain the extent of the diſeaſe before beginning an operation. Nothing can have a worſe appearance than that which has actually happened, viz. a ſurgeon beginning that operation in the ham, which he ſhould have attempted rather on the forepart of the thigh; and being forced to change his ground, and to begin a ſecond operation on the forepart of the thigh, or, what is worſe, to cut up the tendon, and follow the diſeaſed artery to the forepart of the thigh, cutting, in ſhort, firſt longitudinally betwixt the hamſtrings, and, after an hour's working perhaps, cutting croſswiſe to reach the forepart of the thigh.

6thly, Is it not a matter of very high importance to ſtudy the ham ſtill more carefully than the axilla, ſince the artery is ſo often hurt at this place by rude motions of the joint? For it is a narrow cavity; the artery lies cloſe upon the joint and bones; and when it is allowed to remain long in a diſeaſed ſtate, enlarging and dilating the ham, we perform in the end a hopeleſs operation; or, if we had hopes when we began

gan our operation, they are all over before it is ended: for the parts are found to be diſeaſed, the bones carious, the joint ſpoiled; there is no hopes even of preſent ſafety, and of the ligature holding, and much leſs any expectation of a permanent cure. Often the greateſt ſurgeons have been contented to finiſh ſuch an operation by cutting off the limb!

7thly, When the artery has gone down beyond the ham, and ſeems lodged ſafely under the gaſtrocnemii muſcles, ſtill it is not ſafe; it is bended tenſe over the back of the joint; it is preſſed by the gaſtrocnemii ſtretching over it; and their violent action has often been ſuch, as to have torn the artery with a tumour ſo immediate, and with ſuch excruciating pain, that the ſurgeon has been conſtrained in a manner to cut off the limb even upon the ſpot.

8thly, Very often we are obliged to decide, whether a tumour of the thigh or a tumour of the ham can be cut away only by our knowledge of theſe arteries. How often the anterior arteries of the leg are cut by workmen, and how much they are expoſed to the ſtroke of the adze or axe, every practical ſurgeon muſt know: but the miſchances that open arteries are quite unthought of. I have known a man ſtanding careleſsly by his ſcythe, which was ſet upright, the blade along the ground, and the ſhaft reſting upon his arm, cut the artery behind the outer ankle ſo as to form (when the wound healed) a large, livid, and ſtrong beating aneuriſm, ready to burſt, and requiring immediate operation.

The epigaſtric artery is in danger in operations for hernia. The femoral artery is the ſubject of frequent operations; the popliteal aneuriſm is a diſeaſe of this artery in the ham; and even the ſimple operation of amputating either the limb itſelf, or tumours in the thigh or ham, requires a perfect knowledge of all theſe arteries.

But although no formal operation affected theſe leſſer arteries, yet the main artery itſelf is ſo expoſed, and ſo ſuperficial where it runs down the thigh, that it is wounded in a hundred various ways. It is very ſingular how often it has been wounded by one particular accident, viz. the dropping of a pair of ſciſſars, and with a ſudden inſtinctive effort clapping the knees together to catch them. It has been wounded once or twice by a ſhoemaker clapping his knees thus together to catch his ſharp-pointed paring-knife. One of my pupils lay three months in London, uncertain whether his femoral artery was wounded; for he had in this way catched his pen-knife, the point of which had run into his thigh, and wounded ſome great artery. It has been cut acroſs by balls; it has been wounded even by a ſingle ſlug; it has been uncovered by wounds which yet did not touch its coats, and has in conſequence dilated into an aneuriſm. I have known a boy ſtab another with a penknife in the thigh, and ſtrike ſo critically as to open the artery with a wound like that of a lancet. My friend Mr. Harkneſs gave me the privilege of diſſecting an aneuriſmal limb which he was obliged to cut off; and in which the artery was (if I may uſe ſuch an expreſſion) broken or torn acroſs the upper end of the thigh-bone, which had been broken by a fall about three weeks before.

All theſe accidents muſt come upon the ſurgeon very ſuddenly; and if they come upon him unprepared, all is in a moment loſt. I once ſaw a fine young fellow die from this alarm of the attendants and confuſion of the ſurgeon. He was a tall, ſtout, young man, who was ſitting at table with his companions eating bread and cheeſe, taking his glaſs, and telling his tale. He had in his hand a ſharp pointed table knife, which he happened to hold dagger-wiſe in his hand, and in the height of ſome aſſertion or oath he meant to ſtrike the table, but the point miſſed, and ſlented over the table; he had ſtabbed himſelf in the femoral artery, and with one guſh of blood he fell to the ground. When I came, I found the young man ſtretched out upon the floor; he was juſt uttering his laſt groan; the floor was deluged, all ſlippery, and ſwimming with blood. The wound was covered with a confuſed bundle of clothes, which I inſtantly whirled off; and in that moment two gentlemen, who had been firſt called, and who had both run off for tourniquets (becauſe tourniquets are uſed to ſtop bleedings), returned; and had the unhappineſs to ſee that the hole was no bigger than what I could cloſe, and had actually ſhut up with the point of my thumb; and which, had it been ſhut and put together with a good compreſs, would have healed in three days, forming a large beating aneuriſm within, allowing time for a deliberate operation.

In ſhort, to enumerate the variety of accidents which may affect this artery would be impoſſible; but ſurely from the little that I dare venture to ſay in this place, it muſt ſeem one of the largeſt, the moſt expoſed, and moſt dangerous, and by all this the moſt important, artery in the body; and from theſe previous hints and general deſcriptions, the value of the ſeveral branches which are now to be enumerated will be more eaſily felt and underſtood.

BRANCHES OF THE FEMORAL ARTERY.

ABOVE THE GROIN.

THE FEMORAL ARTERY above the groin, that is, juſt before it paſſes from under the ſocro-ſciatic ligament, gives off two very ſingular arteries, which turn backwards and never appear in the thigh; the one, going upon the forepart of the belly on the inner ſide, is the epigaſtric artery; the other, turning backwards along the inner ſurface of the haunch-bone, is named circumflexa ilicum.

ARTERIA EPIGASTRICA.

THE EPIGASTRIC ARTERY, ſo named from its running up along the belly, goes off from the inner ſide of the femoral artery about an inch before it paſſes out into the thigh.

The epigaſtric, when firſt given off, turns downwards with a full round turn till it touches Poupart's ligament. The peculiarity of its courſe here muſt be very carefully attended to. The femoral artery lies at the very outer margin * of the opening, called the crural arch. The Fallopian ligament forms the upper

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* Viz. that end of the ſlit or arch which is neareſt to the haunch-bone.

line of the crural arch. The epigaſtric artery moves inwards and downwards with the Fallopian ligament, running along its lower edge; then it croſſes the opening called the abdominal ring, behind the ring, and alſo behind the ſpermatic cord which paſſes through the ring; then it mounts by the border of the tranſverſe muſcle, and gets to the rectus muſcle of the belly; but it is pretty high before it touches the ſide of the rectus, and lying on the outſide of the peritoneum, and on the inner ſurface of the rectus muſcle, and keeping in the direct line of the rectus muſcle near its centre, or rather nearer the outer edge of the muſcle, and inclining inwards, it mounts from the groin to a little below the borders of the thorax, where it inoſculates very freely with the internal mammary artery. Theſe are the inoſculations which were mentioned page 346. Through its whole courſe this artery is ſo large as to make its wounds important: we ſhould know where to ſtop it in wounds; we ſhould remember to avoid it in opening or extirpating tumours. I have ſeen ſome confuſion and much loſs of time during an operation from not attending to this. The main artery muſt be remembered; its branches are of little value. The only branches which it is at all neceſſary to mention are, firſt, one ſmall twig, which it ſends downwards along the ſpermatic cord; ſoon after entering under the abdominal muſcle, it gives off a large branch almoſt equal to the artery itſelf, which goes directly towards the navel, and ends there. This branch goes obliquely acroſs the muſcle, while the main artery follows the general line of the muſcle, and gives branches on every ſide to the rectus, tranſverſalis, obliquus; in ſhort to all the muſcles of the abdomen, and ſpreads its laſt branches very freely about the lower border of the cheſt.

ARTERIA CIRCUMFLEXA ILEUM.

THE CIRCUMFLEX ARTERY of the HAUNCH is named CIRCUMFLEXA from its turning directly backwards, and ILEUM from its paſſing along the hollow of the haunch-bone.

It is ſmaller than a crow-quill; it goes off from the outſide of the femoral artery oppoſite to the epigaſtic, or rather a little lower; exactly at that point where the outer end of the Fallopian ligament begins in the haunch-bone. It runs backwards in a curved line along the hollow of the haunch-bone, curving along with the criſta ilii, or ridge of the ilium, under which it lies. Its line is along the moſt naked part of the bone, where the internal iliac muſcle begins on one hand, and the tranſverſe muſcle of the belly on the other: in ſhort, it runs along all the upper edge of the internal iliac muſcle, quite round almoſt to the lumbar ſpine, where it joins the ileo-lumbar artery by ſmall inoſculations; for at this place the reflected iliac artery, which grows gradually and ſenſibly ſmaller, is almoſt ſpent. There are no remarkable branches which deſerve to be deſcribed or even to be named, unleſs it be one which goes off early, near the head of Poupart's ligament, and gives branches to the ligament, to the ſartorius muſcle which ariſes at the ſame point of the haunch-bone, and to the edge of the iliac muſcle. And as it runs along betwixt the iliac muſcle on the one hand, and the tranſverſe of the belly on the other, it gives many branches downwards to the internal iliac and pſoas muſcles, and to the ſubſtance of the bone; and upwards it gives three or four branches into the abdominal muſcles, which go ſo far along the belly as to inoſculate with all its other arteries.

BELOW THE GROIN.

THESE laſt branches, viz. the epigaſtric and reflected iliac arteries, I aſcribe to the internal iliac; for the artery is ſtill within the abdomen, or at leaſt not without the arch of the thigh.

The femoral artery, until it gets down into the hollow which I have deſcribed, gives no branches, or none with which I would chooſe to confound the deſcription of the profunda or great artery of the thigh. The branches which the femoral gives off before that are only ſmall twigs to the fat, glands, ſkin, or private parts; but one or two of thoſe to the private parts are ſometimes large.—Firſt, Twigs go out along the femoral ligament, and terminate in the ſkin.—Secondly, Twigs go to the fat, and lymphatic glands of the groin.—Thirdly, There aſcends a ſmall branch, ſometimes towards the origin of the ſartorius, to the middle glutæal muſcles, and to the beginning of the faſcia lata.—Fourthly, Of thoſe branches which go acroſs the upper part of the thigh to the genitals, and which are named PUDICÆ EXTERNÆ to diſtinguiſh their branches from thoſe of the pudica communis, there are uſually three. The uppermoſt is ſcattered about the fat of the pubis. The middle one goes acroſs the heads of the triceps; it is longer and larger than the others; it goes to the ſide of the ſcrotum and penis in Men; in Women it is large, and runs into the labium pudendi. The lower one of the three goes to the lower parts of the ſcrotum, and to the ſkin of the thigh near it.

ARTERIA PROFUNDA FEMORIS.

THEN comes off the profunda femoris, the DEEP or MUSCULAR ARTERY of the THIGH. It ariſes from the femoral artery about four inches below the groin, more or leſs according to the ſize of the ſubject. It turns off from the femoral artery with a bulging, which looks backwards and towards the outſide of the thigh. It lies deep in the triangular cavity, upon the face of the iliacus internus and pectinalis muſcles. It preſently gives off two great arteries, which turn upwards along the joint; one round the outer ſide, the other round the inner ſide, of the joint. Then it paſſes downwards, turns in behind the femoral artery, ſinking deeper and deeper towards the backparts of the thigh. It paſſes down along the face of the triceps muſcle; and as it moves along its forepart, it ſends through three or four great arteries to the backpart, which are called the perforating arteries of the thigh. And, laſtly, the profunda itſelf, or its laſt branch, paſſes through the triceps; and this laſt branch is named perforans ultima vel deſcendens femoris.

ARTERIA CIRCUMFLEXA EXTERNA.

The circumflex artery, which goes to the outſide of the hip-joint, proceeds from the very higheſt point of the profunda. It takes its courſe outwards, paſſing under the ſartorius, faſcialis, and head of the rectus: it runs over the tendinous head of the vaſtus internus, where that muſcle takes its riſe from the outer trochanter: it divides very early into the following branches.—Firſt, Branches go to the inner ſide, to the internal iliac muſcle, upon which this artery lies; and round it they bend over the leſſer trochanter, making inoſculations with the internal circumflex artery.—Secondly, An artery goes in the oppoſite direction, viz. outwards, to the iliac muſcle, the ſartorius, the head of the rectus, the faſcialis, and round to the glutæal muſcles.—Thirdly, It ſends many leſſer branches upwards and forwards into the heads of thoſe muſcles which I have juſt enumerated, and which lie immediately over the artery.—Fourthly, It ſends large branches round the root of the great trochanter, ſome of them going into the hollow above the trochanter; others keeping ſo low as the root of the trochanter, where the greater glutæus is inſerted.—Fifthly, The moſt important of all its branches is a very long one, which it ſends directly downwards under the rectus, or betwixt it and the vaſtus internus muſcle. This artery is divided into two great branches, which run down the whole length of the thigh, ſomewhat reſembling in their ſhape the profunda humeri: they are named the greater and leſſer deſcending branches of the circumflex artery, and they inoſculate in a moſt particular manner with a large anaſtomoſing branch from the femoral artery. The larger branch of this artery emerges from betwixt the rectus and vaſtus externus, a little above the knee, to inoſculate with one of the articular arteries of the knee. Its ſmalleſt branch inoſculates with the anaſtomoſing branch of the femoral artery. Theſe two anaſtomoſes ſeem to be the chief uſe of theſe two long arteries, though they do alſo ſend ſome branches to the muſcles.

But to give a more ſimple notion of this circumflex artery, it ſhould be deſcribed thus. It is divided into three chief branches: 1ſt, A deſcending branch, which goes down to the knee-joint; 2d, A tranſverſe branch, which croſſes the upper part of the thigh, and turns round the neck of the thigh-bone; 3dly, It ſends a leſs important branch up upon the dorſum ilii.

ARTERIA CIRCUMFLEXA INTERNA.

THE INTERNAL CIRCUMFLEX ARRERY is a thick ſhort artery, which goes off oppoſite to the ball of the thigh-bone; and as the external one goes round the great trochanter, this goes round the leſſer trochanter. It is a ſmaller artery; it has not ſo many muſcular branches; it keeps cloſer to the joint; it goes off from the inner ſide of the profunda, juſt oppoſite to the circumflexa externa, or a little lower, but never more than an inch lower; it paſſes over the inſertion of the pſoas muſcle, and under the belly of the pectinalis; it attaches itſelf then to the leſſer or inner trochanter, and goes round the neck of the thigh-bone round the joint, and is expended on the muſcles at the back of the joint, as the quadratus femoris, gemini, &c.

The artery having turned towards the inſide, the muſcles which lie there are the triceps gracilis, &c. The firſt branches, therefore, which this artery gives off before it paſſes under the pectinalis, are to the triceps and gracilis. After having paſſed under the pectinalis, and while it is turning round the root of the leſſer trochanter, it gives branches to the pectinalis and triceps; and eſpecially it gives to the capſular ligament of the hip-joint an artery which is named articularis acetabuli.

The artery now lying upon the pelvis, under the neck of the thigh-bone, divides itſelf into two chief arteries; one goes upwards and forwards along the triceps, till it ends at laſt round the ſymphyſis pubis. The chief muſcular twigs of this branch are given to the triceps, and to the obturator muſcles; it is this branch which inoſculates ſo freely with the branches of the obturator artery; it is a twig of this artery which enters into the cavity of the hip-joint, by that breach which is in the inner edge of the acetabulum; and this branch entering then by its proper hole, goes to the gland in the bottom of the ſocket, or chiefly to it. The other branch turns away in the oppoſite direction, viz. backwards betwixt the little and the great trochanter, turning round the neck of the thigh-bone. It gives branches alſo to the triceps and obturator, inoſculating with the obturator artery. But its chief branches are towards the other ſide, as to the capſule of the hip-joint, to the neck of the thigh-bone, to the quadratus femoris. It is this artery which gives moſt of thoſe branches about the roots of the trochanters named trochanteric arteries; and it is from this artery that many branches go backwards along the tuber iſchii, to unite with thoſe of the ſciatic and pudic arteries.

OF THE PERFORATING ARTERIES.

THE two firſt perforating arteries are very large; the two next perforating arteries are ſmaller and leſs regular; the fifth perforating artery is juſt the termination of the profunda. But ſtill it muſt be underſtood, that theſe perforating arteries are extremely irregular in place, ſize, and number, as indeed all muſcular arteries muſt be; and that there are, beſides the greater perforating arteries, many like them in this part of the thigh, though not diſtinguiſhed by name.

ARTERIA PERFORANS PRIMA.

THE FIRST PERFORATING ARTERY is the largeſt branch of the profunda, bigger than both the articular arteries joined. It ariſes from the profunda, juſt under the leſſer trochanter, betwixt the pectinalis and triceps brevis; and perforates the triceps about an inch below the trochanter, and cloſe upon the thigh-bone. Here the artery lies under the lower edge of the glutæus, and cloſe by the origin of the biceps, ſemi-tendinoſus and ſemi-membranoſus muſcles, the three muſcles which form the hamſtrings; and the chief diviſion of the artery is into one great branch, going upwards along the glutæus, and another going downwards along the flexor muſcles. Firſt, The artery which goes upwards turns over the glutæus, ſpreads innumerable branches about the great trochanter; and meeting with the trochanteric branches of the arteriæ reflexæ, make a moſt beautiful inoſculation, or rather net-work of inoſculations, over the trochanter. Another tranſverſe branch of this upper artery turns quite round the lower part of the trochanter, and round the thigh, among the fleſh of the vaſtus internus; and a third branch of the ſame artery meets in inoſculation with the lower branches of the ſciatic artery.

The lower or deſcending branch of the perforans prima goes down along the three flexor muſcles of the leg, viz. the biceps, ſemi-tendinoſus, and ſemi-membranoſus; nouriſhes their fleſhy bellies, and plays over their ſurface in beautiful net-work.

ARTERIA PERFORANS SECUNDA MAGNA.

THE SECOND OF GREAT PERFORATING ARTERY is a much larger and more important branch of the profunda than this firſt, at leaſt it is ſo when the other perforating branches are wanting, and when this, as often happens, repreſents the continued trunk of the artery: but I ſhall deſcribe it as a ſecond perforating artery, to be ſucceeded by others *. The ſecond perforating artery comes off from the profunda, about two inches lower than the firſt; it paſſes through betwixt the firſt and ſecond heads of the triceps, or

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* My reaſon for ſaying this is, that ſometimes there are but two perforating arteries, while there are often five which need to be deſcribed.

through the fleſh of the ſecond; and turning obliquely downwards and backwards, cloſe by the thigh-bone, it paſſes into the cellular interſtice betwixt the flexor muſcles of the oppoſite ſides, i. e. betwixt the bellies of the hamſtring muſcles, and ends there.

Before it paſſes through the triceps, it gives branches to the triceps and vaſtus, and to the great trochanter, and to the thigh-bone. Its two chief branches, after it perforates the triceps, are, firſt, one great tranſverſe branch, which goes directly acroſs below the tendon of the glutæus, and gives one great branch up upon the glutæus, and another to the vaſtus externus, making inoſculations with the reflected arteries of the joint. Secondly, Its deſcending branch goes down in the hollow betwixt the great hamſtring muſcles, and its branches go into both muſcles, but chiefly into the biceps, and in theſe the artery is exhauſted.

ARTERIA PERFORANS TERTIA.

THE THIRD PERFORATING ARTERY comes off about a finger's breadth lower than the former; it makes a gentle waving turn inwards before it pierces the triceps; and after having perforated the triceps, it gives its branches to both the hamſtring muſcles, but chiefly to the ſemi-tendinoſus.

ARTERIA PERFORANS QUARTA.

THE FOURTH PERFORATING ARTERY may be regarded as the laſt, or as the termination of the profunda, though ſometimes there is a fifth. It perforates again ſtill lower, about a finger's breadth below the laſt, through the fleſh of the triceps magnus. Its firſt branch, while on the forepart of the triceps, is the nutritia magna femoris, or proper nutritious artery of the thigh-bone; and after it perforates the triceps, it gives its arteries to the two hamſtring muſcles, but more eſpecially to the biceps; and ſo this laſt branch of the profunda ends.

But this minute deſcription of any important ſet of arteries never preſents any clear idea to the reader's mind, nor any knowledge which he can eaſily retain. I expect rather to do ſo by one ſhort deſcription.

The title of PERFORATING ARTERIES is one which comprehends all the great muſcular branches of the profunda, except the two reflex arteries belonging to the joint. They vary in number, as all muſcular branches muſt do, and are proportioned in ſize and number to the bulk of the thigh. The profunda paſſes down along the forepart of the triceps, while it is giving off theſe arteries; they muſt, of courſe, perforate the triceps before they can get to the back part of the thigh. When they do perforate, they come into a great muſcular interſtice or hollow, which is formed by the hamſtring muſcles of oppoſite ſides, by the biceps on one ſide, and by the ſemi-membranoſus and ſemi-tendinoſus on the other. It is to theſe two great muſcles of the back part of the thigh that the branches of all the perforating arteries are chiefly directed. Each perforating artery ſucceeds another at about the diſtance of an inch or more; each ſucceſſively coming out into this interſtice at a lower and lower point. Each artery gives branches to the triceps, &c. before it perforates, and to the hamſtring muſcles, &c. after it has come into the hollow. The two firſt perforating arteries are the only arteries which are large and abſolutely certain; the third is always very much ſmaller; the fourth is generally the termination of this great artery; the fifth perforating artery is rare.

Such a general idea as this of their ſize and value, and ſituation in the very heart or deepeſt part of the thigh (for the profunda turns backwards from the very firſt, and all its branches keep the ſame direction), is of more importance than a particular knowledge of every branch of each perforating artery: a thing really unattainable, ſince they vary more in their ultimate branches than almoſt any other arteries in the whole body; for they have more ſpace, and a greater maſs of irregular muſcle to wander in, and produce varieties.

ARTERIA FEMORALIS.

THOUGH the profunda is plainly the artery of the thigh, yet from the ignorance of anatomiſts and ſurgeons (who never knew till about twenty years ago that there was more than one great artery) the ſuperficial artery has been named the artery of the thigh.

The femoral artery makes a ſpiral or ſerpentine turn round the whole thigh. It appears firſt on the forepart; it turns obliquely round to the inner ſide, following the lower edge of the ſartorius muſcle; it paſſes through the triceps, after it has got about two-thirds down the thigh, by which it gets into the ham, and its ſpiral turn is completed. It lies deep where it is giving off the profunda; it riſes then, and is ſuperficial all along the middle of the thigh; and when it has advanced two-thirds down the thigh, it again gets too deep to be felt; but all along it is covered by the thick ſtrong faſcia of the thigh. Through the whole of this courſe it gives no one branch out that is of any conſiderable importance. They are all muſcular arteries, very ſmall, nearly of one ſize, nameleſs, and undiſtinguiſhed, going into the muſcles of the forepart of the thigh; or if any are diſtinguiſhed, it is only by their relation to other arteries, when the trunk gets low enough to make anaſtomoſes with the arteries of the joint.

The nameleſs muſcular branches of the Femoral artery go, in one word, to all the muſcles on the forepart of the thigh; to the rectus, ſartorius, vaſti, gracilis, and triceps; to the glands, faſcia, fat, and ſkin; and it thus continues giving ſucceſſive branches to each of theſe long muſcles as it paſſes the ſeveral points of them.

There is no diſtinguiſhed branch till, having arrived within two hands' breadth of the knee-joint, it gives out (juſt where it is about to paſs through the tendon of the triceps) a larger branch named (like a ſimilar branch of the humeral artery) RAMUS ANASTOMOTICUS MAGNUS.

This branch goes out from the inner ſide of the femoral artery juſt where it is about to perforate the triceps; it paſſes into the fleſh of the vaſtus internus; it firſt ſends ſmaller branches to the vaſtus internus and ſartorius, and through the interſtice of theſe two muſcles to the ſkin of the knee. But having penetrated into the fleſhy belly of the vaſtus internus, this artery, which is itſelf very ſhort and thick, ſends out its ſlender inoſculating branches: one goes downwards along the tendon of the great triceps; and when the tendon of that muſcle ſtops above the inner condyle, this artery goes forwards over the condyle, makes a net-work upon it, joining in numberleſs inoſculations with the articular arteries from below, and gives twigs alſo into the joint. The other branches of this ramus anaſtomoticus tend all forwards and upwards to join the deſcending branches of the reflexa externa, which come down along the rectus muſcle.

There are two other arteries lying cloſe upon the joint, remarkable enough to deſerve a name, and they are called perforating arteries; not perforating like the branches of the profunda, to get deeper among the fleſh; but perforating ſo as to get out from the cavity of the ham upon the ſurface of the thigh again.

The UPPER PERFORATING ARTERY ariſes from the inner ſide of the popliteal artery, juſt after it has perforated the triceps; but it muſt not be accounted a popliteal branch, becauſe it immediately perforates the triceps muſcle again. It gives branches to the ſemitendinoſus, ſemi-membranoſus, and ſartorius; in ſhort, it turns its branches towards the muſcles on the inner ſide of the knee, and is a ſmaller artery.

The LOWER or SECOND PERFORATING ARTERY goes off nearly oppoſite to this. It is much a larger artery. In order to eſcape from the ham, it perforates the ſhorter head of the biceps, or outer hamſtring muſcles. It firſt croſſes the ham at its very upper point, and within the ſubſtance of the triceps; it then perforates the ſhorter head of the biceps flexor-cruris; it then emerges upon the thigh by the belly of the vaſtus externus muſcle. Before it paſſes acroſs the ham, it gives a branch to the ſemi-membranoſus; while it is paſſing through the fleſh of the biceps, it gives a lower nutritious artery to the lower and back part of the thigh-bone; after it perforates the biceps all its branches are to the fleſh of the biceps and vaſtus externus, and its extreme branches are ſpent in inoſculations with the deſcending branch of the reflex or articular artery of the hip-joint.

But theſe branches, which are the laſt of the femoral artery, are extremely irregular. There is no artery from the profunda downwards worth naming, not even thoſe which I have juſt deſcribed *.

POPLITEAL ARTERY.

The artery having paſſed through the ring or tendon of the triceps which is formed for it, or rather having paſſed betwixt the triceps and the bone, lies flat againſt the flat part of the thigh-bone as deep as poſſible in the cavity of the ham. There, as no muſcles are lodged, it can give no muſcular arteries of

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* "Confiteri tamen oportet, binos ultimos ramos in diſtribuendis ſuis ſurculis infinite ludere, ita ut deſcriptione ad quodcunque cadaver adaptata vix, ac ne vix quidem comprehendi poſſint. Ex repetitis tamen meis diſſectionibus id pro certe habeo, duos vel tres, quos perſorantes appellare vellem, exoriri, hos trunculis ſuis ad externum latus præcipue conflecti cumque rete vaſculoſo genu jungi, nutritiant inferiorem ex iiſdem gigni, et ramos inſuper, nunc pauciores, nunc numeroſiores, communicantes ad flexores cum profunda clevari." *Arvidſon*, p. 36.

any importance; none but trivial ones to the hamſtrings or to the heads of the gaſtrocnemii. In its whole length from the place of its perforating the triceps tendon to its great diviſion, which is under the longer head of the ſolæus muſcle, it gives none but articular arteries, i. e. ſmall arteries to the knee-joint, which are no leſs than five in number, and encircle it in all directions.

Firſt, The popliteal artery ſends off from each ſide two muſcular branches, not deſerving a particular name nor deſcription; the one goes to the biceps or muſcle of the outer hamſtring, the other to the ſemitendinoſus and ſartorius, or inner hamſtring muſcles.

Then come off the arteries of the joint, which are thus arranged: 1. The upper arteries coming off above the joint are three in number; one turning round the inner ſide of the joint, and one round the outer ſide, and one in the middle; whence it is named azygous, as having no fellow. 2. The arteries below the joint are two only in number; one to the inner ſide, and one to the outer ſide, of the joint; and theſe directions of the arteries ſettle both the order of deſcription and alſo their names.

ARTERIA ARTICULARIS SUPERIOR EXTERNA.

THAT upper articular artery which comes off above the knee, and which turns round the outer ſide of the joint, ariſes from the popliteal artery above the outer condyle; its trunk is like all theſe arteries about the joints, ſhort and ſtumpy; but its branches long and ſlender. It paſſes under the fleſh of the biceps;

it appears again at the edge of the vaſtus externus: one branch plunges into the vaſtus externus, mounts upwards, and, beſides ſupplying the muſcle, inoſculates with the long deſcending branch of the reflexa externa; while another branch turns as directly downwards over the face of the outer condyle, and ſpreads beautifully over the ſide of the joint, inoſculating in many net-works with the correſponding artery from below.

ARTERIA ARTICULARIS SUPERIOR INTERNA.

THE UPPER ARTICULAR ARTERY of the INNER ſide goes off in like manner over the inner condyle, pierces the tendon of the triceps, where it is implanted into the condyle, and paſſing under the edge of the vaſtus internus, turns towards the forepart of the knee, proceeds towards the patella, and covers chiefly the inner ſide of the joint with its net-work of inoſculations; its little twigs ſlip in under the great lateral ligament, and under the ſides of the patella to the cavity of the joint itſelf. It inoſculates like the outer artery with the lower arteries of its own ſide.

ARTERIA ARTICULARIS MEDIA.

THE MIDDLE OF AZYGOUS ARTICULAR ARTERY uſually ariſes from the back part of the popliteal artery, but ſometimes from one or other of thoſe laſt deſcribed; but this branch, at all events, is ſeldom wanting. It runs down behind the main artery upon the back part of the joint, into the great hollow betwixt the condyles; and all its branches are expended upon the back of the capſule, the poſterior crucial ligament, the ſemilunar cartilages, and the fat about the back of the joint.

LOWER ARTICULAR ARTERIES.

The lower articular arteries are more ſlender, longer, run downwards very low, and return upwards with a very ſudden angle.

ARTERIA ARTICULARIS INFERIOR EXTERNA.

The external ARTICULAR ARTERY below the KNEE goes off from the popliteal at the middle or centre of the joint, turns downwards along with the popliteal artery for a conſiderable way; it paſſes under the heads of the ſmall plantar muſcle and the outer head of the gaſtrocnemius, and having paſſed through, encounters the head of the fibula, and paſſes above it to the ſide of the joint, ſpreading its branches towards the patella.

In the ham this artery gives muſcular branches to the heads of the muſcles, as of the gaſtrocnemius, ſolæus, plantaris, and the popliteal muſcle, that muſcle which lies obliquely acroſs the ham. When it reaches to the ſide of the joint, it paſſes under the external lateral ligament; and ſeveral of its branches, beſides their external anaſtomoſes, go into the cavity of the joint, one of which within the joint is eſpecially large.

ARTERIA ARTICULARIS INFERIOR INTERNA.

The INTERNAL ARTICULAR ARTERY below the knee is larger than the external one. Like it, it bends downwards, paſſes under the inner head of the gaſtrocnemius muſcle, croſſes behind the head or rather neck of the tibia, on the inner ſide of the knee. It firſt gives arteries to the back of the joint; then it communicates downwards with a large recurrent artery from the tibialis antica; it inoſculates upwards with the articularis ſuperior interna; it contributes (as all the other articular arteries do) to the forming of that profuſe net-work of arteries which is ſpread over the whole of the capſule of the knee-joint. It ſends alſo, like the others, certain twigs, which creep under the internal lateral ligament, and go into the cavity of the joint along the borders of the ſemilunar cartilages.

Thoſe who write on aneuriſms of the ham talk much of theſe arteries. They compare them with the recurrents of the arm; and think, when they ſee five articular arteries, that it is a ſure ſign that at ſuch a point all is ſafe; when really theſe arteries cannot be of the ſmalleſt ſervice. They are all deſtroyed by the long compreſſion of the popliteal aneuriſm, or are ingulphed in the bag of the aneuriſm. If they ever appear, it is not as inoſculating arteries, enſuring the ſafety of the limb; but as ſmall branches burſting into the ſac, embarraſſing the operator, and confounding every thing, ſometimes filling the ſac a-new with blood, after all was thought to be quite ſafe, and the patient laid in bed.

Before the popliteal artery paſſes under the head of the ſolæus, it gives two long arteries, which run down upon the two heads of the gaſtrocnemii muſcles. It often alſo ſends ſmall twigs to the head of the ſolæus, and to the popliteal and plantar muſcles.

OF THE THREE ARTERIES OF THE LEG AND FOOT.

The three arteries are, the tibialis antica, going on the forepart of the leg; the tibialis poſtica, paſſing deep along the back part of the leg; and the peronea, which is the ſmalleſt and leaſt regular artery of the leg, and which has its name from paſſing down behind the fibula.

The popliteal artery divides below the ham, under the longer head of the ſolæus muſcle, into two arteries, the tibialis antica, and tibialis poſtica. The tibialis poſtica continues its natural direction downwards under the ſolæus muſcle, and behind the tibia.

ARTERIA TIBIALIS ANTICA.

The tibialis antica makes a ſudden turn forwards, perforates the interoſſeous membrane juſt under the lower edge of the popliteal muſcle; paſſes out towards the forepart of the leg, betwixt the heads of the tibia and fibula: but ſtill it does by no means become a ſuperficial artery; on the contrary, it lies deep betwixt the heads of the tibialis anticus and the extenſor of the toes; and is covered here with a very ſtrong faſcia. It is only about ſix inches above the ankle that the leg grows tendinous and naked; there this anterior artery can be felt beating: it lies betwixt the tendons of the tibialis anticus muſcle and that of the extenſor of the toes; it paſſes down along with theſe tendons, through the annular ligament, and over the bones of the tarſus; it ſends one branch acroſs the foot, another forward to the great toe: but the artery itſelf dives betwixt the firſt and ſecond metatarſal bone in the middle of the foot, and ſo gets to the ſole, where it ends in inoſculations with the back arteries.

There is here ſomething like a poſterior recurrent artery; for the tibial artery, before it paſſes out of the ham, gives a ſmall branch which aſcends towards the back part of the joint, and is diſtributed to the heads of the bones, viz. the tibia and fibula, and to the origin of ſome of the muſcles.

ARTERIA RECURRENS.

THERE is here an ANTERIOR RECURRENT, larger than any in the arm, and much reſembling the recurrens interoſſea. It is a branch which comes off from the forepart of the tibial artery, inſtantly after it has perforated the interoſſeous membrane; it turns immediately upwards under the fleſh of the tibialis anticus; it gives many muſcular branches, ſome to the head of the tibialis, others to the upper part of the extenſor digitorum, and branches go round the head of the fibula to the origin of the long peronæus muſcle. One branch goes directly upwards, and ſpreads all over the lower part of the knee-joint, mixing its branches in the common vaſcular net-work.

The tibialis antica gives no other branch of importance, or which ſhould be named, even from the place of this recurrent quite down to the ankle-joint; for this, like the radial, or femoral, or any long muſcular artery, continues giving off branches from either hand to the muſcles betwixt which it runs, of equal ſize nearly, and all equally unimportant. The tibial artery, then, as it runs down the forepart of the leg, gives branches to the Tibialus Anticus on one hand; to the Common Extenſor of the toes on the other hand; and to the Extenſor of the great toe, which is the laſt of the three muſcles that occupy the forepart of the leg. It alſo gives little arteries to the tibia, to the fibula, and to the interoſſeous membrane which lies betwixt them; but ſtill it arrives unexhauſted at the forepart of the ankle-joint.

But before it croſſes the joint (which it does by paſſing obliquely along with the tendon of the great toe), it gives out two malleolar arteries, i. e. two arteries, one to the outer, and one to the inner ankle.

ARTERIA MALLEOLARIS INTERNA.

THE ARTERY of the INNER ANKLE goes off juſt where the head of the tibia begins to bulge. It turns over the inner ankle in many ſmall branches; ſome mounting upwards along the tibia, but more going downwards over the inner ſide of the joint, i. e. over the tibia or inner ankle, over the aſtragalus, and ſome down as low and as far backwards as the heel-bone.

ARTERIA MALLEOLARIS EXTERNA.

THE ARTERY of the OUTER ANKLE goes off a little lower down. Its ſends ſmaller branches upwards round the outer ankle, which go to the Peronæus Brevis muſcle, to the joint, and to the common extenſor of the toes, inoſculating round the outer ankle with the fibular arteries. But its chief branch deſcends along the forepart and outer ſide of the foot, gives twigs to the ſhort extenſor of the toes, and ends in inoſculations with the tarſeal arteries, or arteries belonging to the forepart of the foot.

The arteries which belong to the forepart of the foot are uſually three in number: One goes off from the tibial artery a little above the ankle-joint, and is named Arteria Tarſea, becauſe it croſſes the foot over the bones of the tarſus. To this ſucceeds a ſecond about the diſtance of half an inch from it, and which croſſes the foot at the place of the metatarſal bones; it is named Arteria Metatarſea: and the one or other of theſe gives the interoſſeous arteries, accordingly as the one or the other is ſmall or wanting. The third is that remarkable branch which goes forwards along the great toe, whence it is named Arteria Halucis.

ARTERIA TARSEA.

THE TARSEAL ARTERY, which is ſometimes of a very conſiderable ſize, almoſt equal to the tibialis itſelf, comes off a little below the ankle, upon the forepart of the foot. It lies upon the ſecond rank of the tarſal bones; it paſſes under the head of the extenſor brevis of the foot; it croſſes the foot obliquely, ſo as to end in the abductor muſcle of the little toe, and in inoſculations with the arches of the ſole of the foot.

This branch gives ſmall inoſculating arteries upwards, which firſt give branches to the joint, and then join with the external malleolar and peroneal arteries. Next it gives branches to the bones and joints of the tarſus, which it lies upon; as the cuboid and cuneiform bones, and their joints. Thirdly, It gives ſmall arteries to the bellies of the extenſor brevis, where it lies under it.

But its greateſt arteries are the interoſſeous arteries, which it ſends along the interſtices betwixt the metatarſal bones. Theſe interoſſeous arteries are three in number; they run along in that interſtice which holds the interoſſeous muſcles; and when they arrive at the end of that furrow, or, in other words, at the place of the forking of the toes, each interoſſeous artery turns down to the ſole of the foot, and goes into the fork of each digital arch, on the loweſt ſide of the toes. Sometimes theſe arteries give alſo ſmall dorſal arteries to the backs of the toes.

The tibial artery having proceeded along the tarſal bones, and arrived at the lower heads of the metatarſal bones, and having firſt given off ſome trivial branches to the joints of the foot on its inner ſide, and to the bones and muſcles about the root of the great toe, next gives off a metatarſal artery *.

ARTERIA METATARSEA.

THE ARTERY of the METATARSUS or inſtep goes off at the head of the firſt metatarſal bone. It bends acroſs the roots of the metatarſal bones to the root of the little toe; and it diſtributes branches to the tendons of the peronæi muſcles, and ends in the abductor of the little toe, and in the ſkin over the outer

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* N. B. Betwixt the tarſal and metatarſal artery, there is uſually a ſmall branch going outwards to the outer edge of the foot, i. e. in the ſame direction with both theſe arteries, but very ſmall.

edge of the foot. But ſometimes it is a larger and more important artery; for when the tarſal artery is ſmall or wanting, this metatarſal one gives off the interoſſei, and ſupplies its place.

DORSALIS EXTERNA HALUCIS.

THE third branch is the ARTERY of the BACK of the GREAT TOE. This artery is of very conſiderable ſize; it gives no muſcular branches, becauſe it lies upon the bony part of the foot; it runs all along the metatarſal bone which ſupports the great toe; and it ends at the forking of that toe in two great branches; one the dorſal artery of the great toe, which goes along it to the point; another to the ſide of the toe next the great toe, which it alſo runs along, ſomewhat like the forking arteries of the thumb and forefinger.

The anterior tibial artery ends here (i. e. where it gives off the artery of the great toe). By ſinking in betwixt the metatarſal bones of the great toe and of the toe next to it, and going directly into the arches of the ſole of the foot, it produces a great and important anaſtomoſis, ſimilar to that of the radial and ulnar arteries.

ARTERIA TIBIALIS POSTICA.

THE POSTERIOR TIBIAL ARTERY is ſo named from its paſſing along the backpart of the tibia. The anterior tibial artery paſſes through the interoſſeous membrane only at the lower edge of the popliteal muſcle: this artery comes off from the general trunk at the upper edge of the popliteal muſcle, and paſſes obliquely towards the inſide of the tibia, to take its place behind that bone. Its whole ſituation and general courſe is this: It lies over the tibialis poſticus and flexor muſcles; it lies under the bellies of the gaſtrocnemius and ſolæus; it turns round the inner ankle cloſe upon the bone. Having paſſed the lower head of the tibia, it goes down along the inſide of the heel-bone, in its deep arch, upon which the body is ſupported; it divides at the heel-bone, and advances along the ſole of the foot in two great branches; one running along the ſole, next the outer edge of the foot; the other along the inner edge of the foot; whence they are named external and internal plantar arteries. From this arch the artery gives branches to all the toes, and ſo it ends.

This poſterior artery is chiefly a muſcular one, at leaſt in its courſe down the leg; and though it gives many branches as it paſſes along, there are hardly any worthy of being deſcribed: and from the knee to the ankle-joint there is one only which needs be diſtinguiſhed by name, viz. the artery which nouriſhes the tibia.

Firſt, The tibialis poſtica often gives arteries to the heads of the gaſtrocnemii muſcles; next it gives off the ARTERIA NUTRITIA TIBIÆ, which begins a little below the lower edge of the popliteal muſcle, runs downwards along the interoſſeous ligament, gives muſcular branches to the popliteus, ſolæus, and tibialis poſticus, and then ſends the nutritious artery into the great hole in the middle of the tibia. It gives many branches to the perioſteum of the tibia, and to the interoſſeous membrane all down the leg, and it ends near the lower end of the tibia in inoſculations with the peroneal artery.

Other nameleſs muſcular arteries ſucceed to this, going to the tibialis poſticus, to the flexor communis, and to the flexor of the great toe. When the artery arrives near the ankle-joint, it gives many ſmall twigs to the perioſteum, tendons, ſheaths, and burſæ mucoſæ behind the ankle; and then paſſing in the very deepeſt part of the ankle, under the annular ligament, and betwixt the tibia or proceſs of the inner ankle and the heel-bone, it adheres cloſely to the bones and capſule of the joint; and there gives a great many little tortuous arteries, making net-works over this joint and its bones, as over the other joints already deſcribed. But eſpecially two delicate arteries go out at this hollow at the ſide of the heel-bone; one forwards towards the ſide of the ankle-joint, the other downwards and backwards over the heel-bone, which ramify very profuſely and very beautifully.

The artery now lying deep under the abductor magnus of the great toe, which ariſes from the heel-bone, forks into its two great branches, the external and internal plantar arteries.

ARTERIA PLANTARIS INTERNA.

THE INTERNAL PLANTAR ARTERY is much the ſmaller branch, not to be compared in importance (though their names are contraſted) with the external plantar artery; and it is named internal, becauſe as it runs along the ſole of the foot it keeps to the inner edge, viz. that to which the great toe belongs. It comes off under the head of the abductor of the great toe, and under the belly of that muſcle, and cloſe upon the bone; its branches run forwards, quite up to the root of the toe, all along its metatarſal bone. The internal plantar artery has in general four branches, which all run pretty nearly in the ſame direction, viz. ſtraight forwards.

It gives, while under the head of the abductor, ſmall branches, which go backwards to the joint, its capſule, and tendons, and ſome into the ſpongy ſubſtance of the heel-bone; ſome alſo to the ſhort flexor of the foot, and to the maſſa carnea. But its four greater and more regular branches are theſe:

The firſt lies nearer the inner edge of the foot; it the largeſt and moſt conſiderable; it runs along under the inner border of the abductor; it goes quite up to the ball of the great toe, and unites with the proper artery of the toe. As it goes along it gives ſmall twigs to the perioſteum and bone.

The ſecond reſembles the former, except that it does not come off ſo early by two inches; it is of courſe ſhorter, but it paſſes along in the ſame direction, only a little diſtant from the firſt, lying along the middle of the metatarſal bone. It alſo advances up to the root of the great toe, and runs alſo into the proper artery of the great toe (which comes from the external plantar branch), ſo as to enlarge and ſtrengthen it.

The third lies ſtill nearer to the centre of the foot, and deeper among the muſcles. It runs the ſame general courſe, viz. along the ſide of the metatarſal bone up to the ball of the great toe, and ending like the others in the artery of the great toe; but as it lies deeper, it gives branches to the ſhort flexor, to the tendons, and to the inner ſurface of the aponeuroſis plantaris, forming a ſort of ſuperficial arch.

From theſe three arteries, much of the ſkin on the ſole of the foot has its branches.

The fourth and laſt branch of the plantaris interna, is one which goes down deep into the centre of the foot; it lies cloſe upon thoſe ligaments which bind together the bones of the tarſus, and under all the tendons, except thoſe of the tibial muſcles which are like ligaments to the bones. Its deſtination is chiefly to the tarſal joints and capſules; its inoſculations with the external plantar artery can be of no importance.

PLANTARIS EXTERNA.

THE EXTERNAL PLANTAR ARTERY is the great artery of the ſole of the foot, from which the arches of the foot and the inoſculations with the anterior tibial artery are formed.

It turns outwards towards the outer edge of the foot; it runs its great circle round by the metatarſal bone of the little toe; and its plantar arch, or the arch of the ſole of the foot, paſſes over the middle of all the other metatarſal bones. It receives the anterior tibial artery under the middle of the metatarſal bone of the great toe. It is this great curve of the artery turning round in the ſole of the foot that we name the plantar arch; and it is from it that all the proper arteries of the toes ariſe, expreſsly after the ſame order in which the fingers receive their arteries.

The great or external plantar artery lies deep, but not upon the naked bones like the former. It paſſes through betwixt the heads of the ſhort flexor and maſſa carnea; it turns its firſt turn outwards, till it gets under the flexor and abuctor of the little toe; then it turns inwards towards the centre of the foot, and lies under the tendons of the long muſcles, and over the metatarſal bones and their interoſſeous muſcles.

Firſt it ſends a large branch backwards to the heel-bone, which belongs entirely to that ſpongy bone, forms, like all ſuch arteries, a ſort of net-work over all the ſurface of the bone; it firſt touches the bone under its extreme point, or that which reſts upon the ground; and it goes branching over it ſo high as to inoſculate round the ankle with twigs of the tibialis antica; it gives branches alſo hereabout to the great ligament of the heel-bone. The external plantar artery next gives branches to thoſe muſcles betwixt which it lies imbedded, viz. the maſſa carnea and flexor brevis; then advancing to the ſide of the flexor digiti minimi, it gives out [illegible] three branches, which firſt go into the fleſh of the abductor and flexor of the little toe, and then turning over the edge of the foot, terminate in inoſculations with the arteries of the fore-part of the foot and in the ſkin.

It then begins from the root of the metatarſal bone of the little toe to form that great circle which is named the arch of the foot, and which gives out two ranks of arteries: Firſt, Of interoſſeous arteries going to the ſpaces betwixt the metatarſal bones, upon which the toes ſtand; and, ſecondly, The proper arteries of the toes themſelves.

The firſt of theſe arteries proceeding from the tarſal arch is a ſmall one, the artery of the little toe. It begins at the lower head of the metatarſal bone, lies under the flexor and abductor muſcles, gives branches to theſe muſcles and to the ſkin, and to the bone itſelf; it runs up the outer edge of the little toe, and this is immediately ſucceeded by the firſt interoſſeous artery; which lies deeper, paſſes along the firſt interoſſeous ſpace, gives branches to the bones and interoſſeous muſcle, and inoſculates betwixt the toes with the branches of the anterior tibial artery.

The next artery is properly the firſt of the great arch. It is what is called the RAMUS DIGITALIS, or proper artery of the toes. It is a long artery, runs over the interoſſeous ſpace lying upon the interoſſeous muſcles; it advances to the root of the little toe, and like thoſe of the fingers divides into two branches, one to the inner ſide of the little toe, and the other to the ſide of the toe next it.—A ſecond and a third DIGITAL ARTERY go out in the ſame manner, and ſplit at the roots of the toes in[illegible] branches, and with ſo little variety that it is needle[illegible] deſcribe each part.

In the interſtices of each of theſe arteries lie two or three ſmall perforating arteries, which perforating betwixt the metatarſal bones inoſculate with the interoſſeous arteries which lie on the forepart of the foot.

But the great external plantar artery, while it is giving out theſe arteries alternately, i. e. large branches to the toes, and ſmaller twigs to the interoſſeous muſcles, and ſome ſmaller ſtill which go off from the concave part of the arch, and go into the ſole of the foot to the ligaments and joints; the great artery goes ſtill onwards, and completes its arch at the middle of that metatarſal bone which ſupports the great toe. There, a little behind the ball of the great toe, it receives the tibialis antica, which perforates from the forepart of the foot. This completes the arch of the anterior and poſterior arteries, and permits the blood to paſs, according to the preſſure or other accidents, in either direction; and this union ſtrengthens and enlarges the artery of the plantar arch ſo much, that it is not exhauſted by the many branches which it has given off, but gives at this point the largeſt artery of all, viz. the artery which ſupplies the great toe and one ſide of the toe next it. This artery of the great toe is the very laſt or extreme branch of the aortic ſyſtem. It very cloſely reſembles the great artery of the thumb; it gives out three chief branches, viz. one to each ſide of the great toe, and one to the inner ſide of the toe next it. This ARTERIA POLLICIS PEDIS ſometimes ſeems to proceed entirely from the perforating branch of the anterior tibial artery; at other times it ariſes fairly from the plantar arch.

ARTERIA PERONEA.

THE FIBULAR ARTERY, or the third artery of the leg, which is much ſmaller than theſe two, is to be regarded rather as a branch of the anterior tibial artery; and in its courſe and connections, and its being exhauſted nearly by the time it reaches the ankle-joint, it greatly reſembles the interoſſeous of the fore-arm, which ſtops below the wriſt, or paſſes it only with ſmall and extreme branches.

Where the tibialis antica paſſes through the interoſſeous ligament, the arteria peronea breaks off from it, almoſt of equal ſize with itſelf, and paſſes down behind the fibula, whence it has its name. It ariſes near the head or origin of the tibialis poſticus muſcle, and accompanies that muſcle down to the ankle-joint, lying betwixt it and the flexor of the great toe.

This is entirely a muſcular artery for ſupplying thoſe deeper parts which the other arteries do not ſupply. Its branches, like thoſe of all muſcular arteries, are extremely irregular; its chief branches are to the ſolæus, to the peronæi muſcles, to the tibialis poſticus, to the flexor of the great toe. Several little arteries turn round the fibula from point to point, going to the fore-part of the leg. All the way down the leg, it is giving off repeated branches to the ſame muſcles; and in this courſe it gives ſome little arteries, which pierce through the interoſſeous membrane, and alſo gives the nutritious artery of the fibula.

When it approaches the ankle-joint, the fibular artery gives off an anterior branch, which perforates the interoſſeous membrane, paſſes through betwixt the tibia and fibula nearly where they are joined; it turns downwards over the outer ſide of the ankle, by the extenſor pollicis and peronæus brevis tendons. This is named PERONEA ANTERIOR, though it is an artery of little importance. Its branches are given not to muſcles, for this is a naked and bony part of the foot; but are expanded upon the lower heads of the tibia and fibula, and upon the os cuboides. They nouriſh the tendons, ligaments, and burſæ of the outer ankle; they end in inoſculations with the malleolar artery, from the tibialis anterior, and with the tarſal artery.

ARTERIA PERONEA POSTERIOR.

As this ANTERIOR FIBULAR ARTERY branches over the fore-part of the outer ankle, the POSTERIOR FIBULAR ARTERY paſſes deep behind the ſame ankle, and is juſt the continuation of the main artery; which having paſſed down behind the acute angle of the fibula, ſinks into that deep hollow which is behind it upon the ſide of the heel-bone. Behind the tibia the artery makes large inoſculations with the poſterior tibial artery, and gives many branches to the tendons. Branches alſo turn round the ankle, making a net-work of veſſels upon it, and inoſculating with the anterior tibial artery. It continues to give the ſame ſmall arteries to the outer ankle, to the peronæi tendons, to the outer ſide of the heel-bone, and to the abductor of the little toe. It ends uſually in that muſcle, and in inoſculations with that branch of the external plantar artery which turns backwards upon the heel-bone and ramifies upon it ſo beautifully.

Theſe are the laſt branches of the three great arteries of the leg and of the aortic ſyſtem.

FINIS.

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